DOWNLOAD PDF SCIENTIFIC AMERICAN: TRIUMPH OF DISCOVERY

Chapter 1 : Missing tape discovery solves year lunar mystery | PBS NewsHour

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It fulfilled a prediction made years ago by Albert Einstein and capped a year quest to spot the infinitesimal ripples. But instead of the end of the story, scientists see the discovery as the birth of a new field: In , Einstein explained that gravity arises because massive bodies warp space and time, or spacetime, causing free- falling objects to follow curved paths such as the arc of a thrown ball or the elliptical orbit of a planet around its sun. Einstein then calculated that a barbell-shaped distribution of mass whirling end-to-end like a baton should radiate ripples in spacetime that zip along at light speedâ€"gravitational waves. The triumph was hard earned. Einstein himself vacillated for decades over whether gravitational waves should exist. Even if they did, the only source Einstein could imagine, two orbiting stars, would produce waves too feeble to detect. By the late s, however, astrophysicists knew of much denser concentrations of mass. They had spotted neutron stars and dreamed up black holes, the ultraintense gravitational fields left behind when massive stars collapse to nothing. Spiraling together, such things could, in theory, produce observable waves. In , Rainer Weiss, a physicist at the Massachusetts Institute of Technology in Cambridge, set out a scheme to detect them with L-shaped optical instruments called interferometers, sowing the seed for LIGO. Now, physicists are eagerly anticipating what may come next, because gravitational waves promise an entirely new way to peer into the cosmos. First, physicists hope to spot many more events. LIGO already has detected a second black hole merger and a third, weaker signal. The interferometers resumed taking data last month, and if they can reach their design sensitivity, they may eventually see a black hole merger on average once a day. Other instruments will soon join the hunt. Three or more detectors together should be able to pinpoint a source in the sky by triangulation. That could help telescopes home in on the same event, and perhaps detect other signals from it. For example, if gravitational wave detectors sense the merger of two neutron stars and telescopes pick up light or x-rays from it, the signals together might offer clues about the exotic matter in neutron stars. The detectors might even test wilder ideas about black holes. If so, merging black holes should produce gravitational wave echoes, some theorists predict. Others speculate that a spinning black hole could generate a cloud of hypothetical particles called axions, which could generate gravitational waves by annihilating one another en masse.

Chapter 2 : Eight great American discoveries in science - Technology & science - Science | NBC News

Scientific American, as an institutional author, is a popular science magazine founded by Rufus M. Porter and controlled by Nature Publishing Group since autumn, Mariette DiChristina has been editor-in-chief since December,

Earlier observations[edit] Neptune is too dim to be visible to the naked eye: Neptune would appear prominently even in early telescopes so other pre-discovery observation records are likely. However, so far there is neither clear evidence that he identified this moving object as a planet, nor that he published these observations of it. There is no evidence that he ever attempted to observe it again. Walker of the U. Naval Observatory searched historical records and surveys for possible prediscovery sightings of the planet Neptune. In the catalog observations for May 8 and again on May 10 of a star was observed in the approximate position expected for Neptune. The uncertainty of the position was noted with a colon. In an letter to Wilhelm Struve , John Herschel states that he observed Neptune during a sweep of the sky on July 14, Although his telescope was powerful enough to resolve Neptune into a small blue disk and show it to be a planet, he did not recognize it at the time and mistook it for a star. At position a, Neptune gravitationally perturbs the orbit of Uranus , pulling it ahead of the predicted location. The reverse is true at b, where the perturbation retards the orbital motion of Uranus. Adams learned of the irregularities while still an undergraduate and became convinced of the "perturbation" hypothesis. After his final examinations in , Adams was elected fellow of his college and spent the summer vacation in Cornwall calculating the first of six iterations. John Couch Adams In modern terms, the problem is an inverse problem , an attempt to deduce the parameters of a mathematical model from observed data. Though the problem is a simple one for modern mathematics after the advent of electronic computers , at the time it involved much laborious hand calculation. He then calculated the path of Uranus using the assumed position of the perturbing body and calculated the difference between his calculated path and the observations, in modern terms the residuals. He then adjusted the characteristics of the perturbing body in a way suggested by the residuals and repeated the process, a process similar to regression analysis. The story and date of this communication only seem to have come to light in a letter from Challis to the Athenaeum dated 17 October Le Verrier located Neptune within one degree of its discovery position. Only after the discovery of Neptune had been announced in Paris and Berlin did it become apparent that Neptune had been observed on August 8 and August 12 but because Challis lacked an up-to-date star-map, it was not recognized as a planet. On 31 August, Le Verrier presented a third memoir, now giving the mass and orbit of the new body. Having been unsuccessful in his efforts to interest any French astronomer in the problem, Le Verrier finally sent his results by post to Johann Gottfried Galle at the Berlin Observatory. Neptune was discovered just after midnight, [1] after less than an hour of searching and less than 1 degree from the position Le Verrier had predicted, a remarkable match. After two further nights of observations in which its position and movement were verified, Galle replied to Le Verrier with astonishment: There was much criticism of Airy in England. Adams was a diffident young man who was naturally reluctant to publish a result that would establish or ruin his career. Airy and Challis were criticised, particularly by James Glaisher , [3] as failing to exercise their proper role as mentors of a young talent. Challis was contrite but Airy defended his own behaviour, claiming that the search for a planet was not the role of the Greenwich Observatory. On the whole, Airy has been defended by his biographers. I mention these dates merely to show that my results were arrived at independently, and previously to the publication of those of M. Galle, so that the facts stated above cannot detract, in the slightest degree, from the credit due to M. Further, it was suggested that they both succeeded in getting the longitude almost right only because of a "fluke of orbital timing". This criticism was discussed in detail by Danjon [2] who illustrated with a diagram and discussion that while hypothetical orbits calculated by both LeVerrier and Adams for the new planet were indeed of very different size on the whole from that of the real Neptune and actually similar to each other , they were both much closer to the real Neptune over that crucial segment of orbit covering the interval of years for which the observations and calculations were made, than they were for the rest of the calculated orbits. So the fact that both the calculators used a much larger orbital major axis than the reality was shown to be not so important, and not the most relevant parameter. By contrast, Le Verrier was arrogant and assertive, enabling the British scientific establishment to close ranks behind Adams while the French, in general, found little sympathy with Le Verrier. Eggen after his death. Eventually the telescope was moved to the Deutsches Museum in Munich , Germany, where it can still be seen as an exhibit.

Chapter 3 : A Timeline of Tragedy and Triumph - Scientific American

A Timeline of Tragedy and Triumph. From the great ocean liner's construction to its sinking to its discovery on the ocean floor, the key moments in Titanic's history Scientific American is.

The slipway used to build the Titanic is the biggest ever constructed, taking up three of the existing slipways at the shipyard. Construction causes injuries and eight deaths. The ship is then towed out to a spot where her engines, funnels and other parts can be installed and the interior finished. The ship is sailed at different speeds, turned and stopped. Overall it goes about 80 miles during the tests and returns to Belfast to have the paperwork signed declaring the ship seaworthy. As the ship leaves the dock, it is so big that it pushes many of the smaller ships up and then down into the trough of its wake. One ship, the New York, breaks away from its cables as it is pulled into the wake and almost collides with the Titanic. It takes about an hour to get the New York under control and the Titanic out of the docks. The ship picks up additional passengers in Cherbourg, France, and later that evening sets out for Queenstown, Ireland. April 11 The Titanic makes a safe stop in Queenstown, Ireland to pick up more passengers and mail, and then at 1: April 14 The Titanic gets warnings from other ships that there is ice drifting around Newfoundland: Have had moderate variable winds and clear fine weather since leaving. Wish you and Titanic all success. Saw much heavy pack ice and great number large icebergs. Thirty-seven seconds later, the Titanic hits the iceberg on its starboard side. The ice bashes several holes into the side of the ship. After 10 minutes, the water pouring in is 14 feet above the keel in the forward compartments. Captain Edward John Smith orders the crew to get the lifeboats and begin boarding women and children first. Lifeboats begin to be lowered from the deck into the water. The noise of the steam escaping from the vents on the deck is so loud that the man in charge of directing lifeboat operations has to use his hands to give directions. The Carpathia, a ship nearby, is alerted to the emergency. Its captain, Arthur H. Rostron, wires that he is coming to their rescue. The Carpathia is only 58 miles away. This is only the second time the SOS code has ever been used since its approval. Another officer begins to send up distress rockets to try and alert other ships. The last of the Titanic disappears under the water. Final figures cannot be known because official counts are done only after a ship reaches its destination to account for stowaways and passenger movement at ports. The Carpathia arrives at the site of the sinking. The surviving passengers and crew, in all, board the ship and head for New York. Carpathia docks at Pier 54 in New York City before a crowd of people numbering 40,, despite a heavy rain. Aid organizations have blankets and clothes for the surviving passengers. The Carpathia is quickly restocked to resume her trip to Fiume, Austria-Hungary, and her crew is given a bonus. Navy and the Woods Hole Oceanographic Institution set out to find and map two sunken nuclear submarines lost in the same area. They find that as a submarine sinks, parts and contents of the ship spread across a wide area into a debris field far larger than the size of the shipâ€"a clue important for figuring out how the Titanic debris might have scattered. July The second expedition to map these nuclear submarines launches. Navy agrees to let oceanographer Robert Ballard look for the Titanic in whatever time he has left after mapping the submarines. This gives him 12 days to find the wreck that has been lost for 73 years. September 1 Manmade debris begins to appear on the cameras, eventually leading Ballard and his team to the hull of the Titanic. Their removal from the wreck is very controversial. It remains the highest grossing film in history until another Cameron film, Avatar, breaks the record in The artifacts can be sold, but only to parties who would be able to care for them. You can follow her at roseveleth or check out her website roseveleth.

Chapter 4 : Discovery of Neptune - Wikipedia

Get this from a library! Scientific American triumph of discovery: a chronicle of great adventures in science. [Scientific American, inc.;] -- A collection of essays on scientific innovations, commemorating the th anniversary of Scientific American magazine.

He grew up at The Mount, the family home that overlooked the River Severn. His father, Robert Waring Darwin , was a well-respected and successful physician. From to he attended Shrewsbury School, run by the Revd. At an early age, he developed a passion for collectingâ€"shells, minerals, insectsâ€"and a love of fishing and hunting. But he was not a good student. In , hoping he would make something of himself, his father sent him off to Edinburgh to study medicine. Darwin, however, was not cut out to be a doctor. He attended two operations, but he could not stay to see either finished pre-anesthesia operations were grisly affairs. In desperation, his father sent him to Cambridge to prepare him for the clergy, and it was there that he met John Stevens Henslow, Professor of Botany, who would become his mentor. It was the mere passion for collecting; for I did not dissect them, and rarely compared their external characters with published descriptions, but got them named anyhow. I will give a proof of my zeal: Soon after Cambridge he set out on a voyage that opened his eyes to the incredible diversity of life. These adventures fill our history books and fire our imaginations with the thunder of cannons, the horrors of scurvy, and the discovery of new lands. Yet within this rich tapestry of triumph and disaster, only a few voyages truly altered the course of history. The Beagle expedition is one. Circling the world from to , the Beagle discovered no new continents, fought no decisive sea battles, nor returned laden with gold doubloons, bolts of silk or exotic spices. But onboard was Charles Darwin. He hacked his way through the rain forests of Brazil and clambered to the top of the Andes mountains. He experienced a devastating earthquake which shook the west coast of Chile and explored the tranquil coral islands of the Indian Ocean. The voyage presented a rare opportunity for a naturalist to accompany the expedition and Henslow recommended Darwin. Getting Darwin on board, however, was fraught with difficulties. At one point, the position was offered to someone else. But I think he was afterwards well satisfied that my nose and spoken falsely. Letters flew back and forth; interviews were scheduled and canceled; plans made and abandoned. Darwin overcame one obstacle only to face another, but his destiny prevailed. Beagle by crew member Philip Gidley King. FitzRoy warned Darwin that space was tight, but nothing prepared him for what he found at Devonport on Tuesday, September The Beagle carried more than seventy men, and in order to sleep at night, Darwin had to remove a drawer to make room for his feet. Lack of space, however, was the least of his problems. Twice the crew departed only to be driven back by gales. Finally, on December 27, they set out for good on their five year adventure. And the first thing Darwin learned was the agony of sea-sickness. He was ill almost the entire voyage, scarcely able to get out of his hammock whenever the ship was at sea. Finding it impossible to even stand up without becoming seasick, Darwin wondered if he made a serious mistake. FitzRoy did not hesitate. Not only did Darwin want to visit the island, he desperately wanted to stand on dry land. Fortunately, the break he needed was not far off. Expecting it to be uninteresting, Darwin found it electrifying. For the next year, the Beagle made its way down the coast, conducting surveys, taking soundings and drawing charts, while Darwin collected insects, seashells and rocks. He did not put the pieces together until he returned to England, but it was thereâ€"in the heart of South Americaâ€"that Darwin made his first important discoveries. Everywhere he looked was a ruthless struggle for survival: One was a giant sloth similar to the present-day slothâ€"but much bigger. There were also bones of a giant llama and a giant armadillo. Darwin marveled at their close resemblance to modern species. Darwin had read volume one, but volume two conveyed a more profound message. Lyell argued that the Earth was much older than most people imagined and that the same geological processes observed in modern times had been at work for millions of years. In fact by the s all geologists accepted that the world was very ancient, but no one could guess just how old. In his second volume, Lyell argued that species became extinct because they no longer fit their environments as the world changed. Just how new species came into existence was not quite as clear. Somehow they might have be created to fit new environments. Perhaps by similar causes? Eventually, the ship made its way back to Tierra del Fuego, where Darwin encountered another key piece of information. Darwin was baffled by the presence of two similar kinds of birds in the same territory. He learned it lived south of the Rio Negro, while the larger one lived only north of the river. Thus, Darwin acquired a small but important fact: After two weeks she headed north to Valparaiso, Chile. From there Darwin struck out for the foothills of the Andes and reached Santiago on August In September he fell seriously ill and barely got back to Valparaiso before collapsing for a month, unable to get out of bed. Upon recovery, the first news he heard was bad: FitzRoy had suffered a nervous breakdown and had given up command of the Beagle. Ever the perfectionist, the captain had pushed himself too far and had snapped. His officers, however, eventually convinced him to retake command and complete the journey. On an excursion across the island, Darwin observed three volcanoes billowing smoke, and on January 19 he saw Mount Osorno erupt. At midnight the sentry reported a fire on the horizon. At three in the morning, Darwin and the rest of the crew stood on deck to watch the explosion of rock, fire and lavaâ€”so bright it lit up the sky. The Beagle then sailed north to Valdivia. While exploring inland the ground shook as an earthquake struck the west coast. Two hundred miles north at Concepcion, the cathedral was left in ruins and a twenty foot tidal wave hit the city, carrying a schooner into the center of town. Amidst the wreckage, however, Darwin made another important discovery: The ground had risen several feetâ€”proof that Lyell was right. Indeed, over millions of years, the continents rise and fall, creating and destroying mountains and reshaping the world in small, imperceptible steps. As winter approached, the ship again made its way north to Valparaiso and Darwin set out for the Andes with guides and mules. Making his way back to Santiago, he pushed on through the mountains to Mendoza, Argentina, shivering through night frosts at 13, feet and fighting against the thin air, freezing winds and icy clouds. He spent one night in a small village just south of the city and he remembered it well. He wrote in his Journal: Before sucking they are quite thin, but afterwards become round and bloated with blood, and in this state they are easily crushed. His lifelong health problems may have started in Argentina. Turning northwest he crossed back through Uspallata Pass and stumbled across fossilized trees, a petrified forest at the top of the world. The trees once must have stood on the coast, when the ocean had come up to the foot of the mountains. Buried when the continent sank, they were buried in silt, then thrust to the top when the continent rose up again, the trees were tilted at impossible angles, jutting out from the rock that had crumpled like paper. Darwin was slowly working out the puzzle. Six hundred miles off the coast of South America, the landscape was bleak and prehistoric, covered with black sand and lava, the islands cut in half by the equator. Beagle in the Galapagos Islands. Painting by John Chancellor. Exploring James Island San Salvador , Darwin found a large salt lake and stumbled over the skull of a captain murdered by his crew years before. He rode on the backs of the giant tortoises and played with huge, iguana-like lizards, up to three feet in length, entertaining himself by throwing cactus branches into their midst, triggering little tugs-of-war between the miniature dragons, which grabbed the ends in their sharp teeth. The great variety of birdsâ€”hawks, mockingbirds, water-sails, and heronsâ€”were clearly related to birds of South America but with significant differences. This puzzled Darwin and later proved critical to the development of his theory. And then there were the finches. It was not until that ornithologist John Gould sorted them out and identified thirteen different species of finch in the Beagle collections. Geospiza magnirostris, a large ground-finch found in the Galapagos Islands. In fact, the tortoises provided a better clue: In Australia, Darwin came across eucalyptus trees, the kangaroo rat and the bizarre duck-billed platypus. The plants and animals he saw were much different from anything he had seen before. Here Darwin found giant clams, brightly colored corals and emerald lagoons. At Keeling, Darwin tested his new theory of coral reefs. He had theorized they were formed when mountains sank back into the sea, the coral reefs that originally surounded the islands were left as rings around a lagoonâ€”and he was right. Often thought of as an evolutionary theorist, Darwin was, in fact, an accomplished geologist, botanist and zoologist. The ship did not stay long in this tropical paradise before setting out across its third great body of water, the Indian Ocean.

Chapter 5 : Scientific American | Open Library

Scientific American triumph of discovery: a chronicle of great adventures in science. by Scientific American, inc. Publication date Internet Archive Books.

View Issue On February 11, , ecstatic scientists worldwide basked in the announcement that the Laser Interferometer Gravitational Wave Observatory LIGO had detected gravitational waves produced by the merger of two black holes more than a billion light years from Earth. Many members of the cosmological community had waited, literally, most of their lives to hear that announcement. At least one has confessed that his eyes welled with tears. Additional detections have been announced on a regular basis; most spectacularly, on August 17, , the facility recorded gravitational waves produced by the collision of two neutron stars. Along the way, each press release or media report has been accompanied by a formulaic nod, intended to provide the ultimate seal of approval on the findings: Contrary to conventional wisdom, Einstein was not the only physicist in the early 20th century attempting to create a modern description of the gravitational field. With hindsight, we can say that virtually any field theory of gravity will predict gravitational waves, so long as it obeys the fundamental precept that such disturbances must propagate at finite velocity. Furthermore, Einstein himself did not immediately arrive at a definitive result. After completing his general theory of relativity in , he initially dismissed the idea of gravitational waves, and his first paper dedicated to the subject got the description very wrong. Einstein soon hit on the correct formulation, but two decades later he rejected the physical reality of gravitational waves, and he remained skeptical about them for the rest of his life. Like most scientific concepts, that of gravitational waves emerged over many years, through the work of numerous architects. They were merely scientists working in sometimes friendly and sometimes not-so-friendly competition, seeking to solve a long-recognized problem. In those efforts, they may well have believed they were being less revolutionary than evolutionary. Gravitational waves are produced by violent events such as colliding black holes or neutron stars. Color patches on this all-sky map indicate inferred locations of the first detected gravitational-wave signals. Action at a Distance To begin at the beginning: When in Isaac Newton introduced his law of gravity, it described in a single equation the gravitational attraction between any two objects. If the Moon suddenly disappeared, lunar tides would vanish with no delay. Over the next two centuries, such concerns gave rise to the notion of a space-filling field, which can be imagined as the medium that transmits the message. Back then, the existence of fields was less obvious. By the s, however, the creators of hydrodynamics were treating fluid propertiesâ€”velocity, density, pressureâ€”as fields. By treating electricity and magnetism as fields, the Scottish mathematical physicist not only demonstrated that the two were intimately connected, but also showed that electromagnetic fields can propagate as waves at the velocity of light. The conclusion was nearly inescapable: Light itself was an electromagnetic wave. The implications of this discovery for the understanding of gravity were not lost on Maxwell. In a sequel, Heaviside considered how a gravitational field changes when the attracting bodies are moving and the field propagates at finite velocity. He found that the changes in the field would produce small perturbations in the orbital motion of the Sun. The nondetection of such perturbations set an upper limit on the speed of gravity, suggesting it is probably the same as the speed of light. By then, however, the idea that gravity might be propagated at a finite velocity was hardly novel; the French mathematician Pierre-Simon Laplace had enlisted such a hypothesis as early as the s. In , Jonathan Zenneckâ€" remembered now as an important radio pioneerâ€"wrote an article on gravitation for a German encyclopedia. In it, he surveyed multiple proposals to modify Newtonian gravity to make it more closely resemble Maxwellian electromagnetism, which by then many natural philosophers believed was the basis of all physics. Even then it took another half century for Einstein to correctly describe those waves as four-dimensional disturbances traveling at light speed. Special relativity was founded on two immortal postulates. First, that experimenters must always get the same result for any experiment in any frame of reference that is, no matter how fast they are moving relative to each other , as long as they are moving at constant velocity. Second, that observers will always measure the speed of light to have the same value, , kilometers per second, regardless of their motion. These postulates led to the conclusion that no informationâ€"not even the propagation of gravityâ€"can travel faster than light, and they demanded a thorough modification of Newtonian physics. Retardation is the only thing a field theory needs to produce gravitational waves. Longitudinal waves, such as pressure waves in air, oscillate in parallel with the direction of the wave itself top left. Transverse waves oscillate perpendicular to propagation. In the case of transverse light waves, the oscillating electric and magnetic fields are perpendicular to each other as well bottom left. Transverse gravitational waves have a more complicated structure upper right. Cross sections of the wave lower right show that it alternately stretches and compresses space; in this perspective, the wave is coming out of the page toward you. Illustration by Barbara Aulicino Acceleration and Equivalence Within a few years, Einstein understood that gravitation could not be consistently incorporated into his special theory of relativity. In , he realized that there is no experimental way to distinguish an acceleration due to motion from an acceleration due to a gravitational field. In the classic example, a rider in an elevator cannot tell whether the elevator is sitting still on Earth or accelerating at a rate of 9. The two effects are exactly equivalent. Put another way, all masses, regardless of their nature or composition, fall at the same rate in a gravitational field. Special relativity deals only with bodies moving at constant velocity, not accelerating ones. The principle of equivalence showed Einstein that special relativity therefore could not be extended to explain gravity, as some of his competitors were attempting to do. Conversely, a theory that could explain accelerating objects would necessarily give Einstein a new theory of gravity as well. In a paper, Einstein took the first steps in that direction by using equivalence to demonstrate that photons must gain energy as they fall toward a gravitating body and lose energy as they climb away from it. Light emitted by a massive body is stretched, resulting in a gravitational redshift, a phenomenon inconsistent with gravity-free special relativity. Clocks at different heights above a gravitating body likewise tick at different rates. As a resultâ€"or so Einstein initially believedâ€"the speed of light must change in a gravitational field. During his lifetime, though, he was widely acknowledged as a leading physicist, especially in matters of electromagnetism, which he believed was the foundation of all reality. In , Abraham published a theory of gravity in which he modified special relativity somewhat inconsistently to include a variable speed of light along the lines Einstein had proposed. A scalar is merely a quantity temperature, for example that is entirely characterized by its magnitude. However, the living-room temperature may be 20 degrees while the bedroom temperature is 18 degrees, and both values certainly change between dawn and sunset. Thus the house temperature represents a scalar field varying in space and time. They have magnitudes but also point in specific directions. Just as an accelerating electric charge produces electromagnetic radiation, an accelerating mass should emit gravitational radiation. Abraham realized that the waves produced by his theory were longitudinalâ€"that is, the field oscillates along the direction of the propagation of the wave, just as air density fluctuates in the same direction in which a sound wave propagates. By contrast, electromagnetic waves are transverse, meaning that the waves vibrate in a direction perpendicular to the direction of propagation. But a scalar-wave description is often enlisted even today by teachers introducing gravitational waves to students, and in doing so we are following Abraham rather than Einstein. Even as Abraham discussed gravitational waves in relation to electromagnetic waves, he understood that the comparison was not entirely legitimate. By far the dominant type of electromagnetic radiation is dipole radiation, which is emitted when a single electric charge or collection of charges accelerates. One might reasonably think that if a single mass were accelerated it should analogously emit gravitational dipole radiation. However, Abraham maintained that the law of conservation of momentum would forbid a single mass from accelerating without a second mass accelerating in the opposite direction. The event horizon is the place of no return that separates the interior of the black hole from the rest of the universe, and it is still an area of intense theoretical investigation. LIGO facilities in Hanford, Washington, and Livingston, Louisiana, split a laser beam and send it along perpendicular arms, creating a huge Michelson interferometer. If a passing gravitational wave changes the relative lengths of the arms, the phase between the beam halves will shift when recombined. A genuine event produces tightly matching sets of data bottom right. Illustration by Barbara Aulicino The Great Gravity Debate Einstein and Abraham were not alone in their meditations and arguments about the nature of gravitation. The German physicist Gustav Mie â€" also contributed to the scientific ferment. Mie is today remembered primarily for his theory of light scattering off spherical particles. That omission led to a lively exchange during the discussion afterward. Textbooks and popular accounts universally claim that Einstein was the first to equate the geometry of a flexible spacetime placed on the left side of his field equations with the matter affecting that geometry placed on the right , demonstrating the revolutionary idea that mass and geometry are intimately connected. His theory did unquestionably predict them, however; his field equation is precisely an equation for transverse gravitational waves. What is clear is that the time was ripe for general relativity. Five of the events detected so far came from merging black holesâ€”all of them more massive than the known stellar black holes in our galaxy, for unclear reasons. One LIGO event was produced by colliding neutron stars, exposing new details of how this explosive process seeds space with heavy elements. And analysis of the stretching of gravitational waves is providing a novel way to measure the expansion rate of the universe. Next-generation detectors will broaden the reach of gravitational-wave astronomy. A planned third LIGO facility in India will boost the sensitivity and precision of the combined facility starting in the mids. Further ahead, a European consortium is studying the underground Einstein Telescope concept drawing, left , which would vastly surpass LIGO by using nested laser arrays in a triangular configuration. Other efforts will extend the search for gravitational wave searches beyond Earth. It is slated for launch. Four teams are currently attempting an even grander effort to scan for gravitational waves across interstellar distances. They are monitoring groups of pulsars, stellar remnants that emit extremely repetitive pulses of radiation, and searching for subtle time shifts caused by passing gravitational waves right. This approach is especially well-suited to detecting low-frequency waves produced by the merging of supermassive black holesâ€”among the most energetic events in the cosmos, and yet so far invisible to us. There was no mention of gravitational waves in the paper, however. Strangely, it appears that Einstein did not believe in them at the time. He also arrived at the erroneous conclusion that an oscillating spherical mass would produce gravitational radiation in a form known as monopole radiation, something that is forbidden even in electromagnetism. In general relativity, gravity determines the fabric of spacetime, which resembles the surface of a boundless trampoline, capable of being stretched in all directions. Whereas Newton required one equation to describe the force of gravity, Einstein required 10 to describe the entire field. The tensors of relativity embody the coordinates you are using to describe the problem at hand. During any analysis, it is easy to confuse what is happening according to your coordinates with what is taking place in the physical world. In one coordinate system, a wave may appear to be rippling across space, whereas in another coordinate system space may appear absolutely flat. Einstein had fallen into this trap, more or less misplacing the location of gravitational energy.

Chapter 6 : The Secret History of Gravitational Waves | American Scientist

*Scientific American Triumph of Discovery: A Chronicle of Great Adventures in Sc [John H. Gibbons] on calendrierdelascience.com *FREE* shipping on qualifying offers.*

Jump to navigation Jump to search In the past the man has been first, in the future the system must be first. Taylor Industrial capitalism was running up against renewed resistance from the growing ranks of labor, still committed to a sense of work integrity and craftsmanship. The heart of this approach is the systematic reduction of work into discrete, routinized tasks, totally separated from any policy decisions about the job. For capitalism to be firmly in control, it must monopolize information and techniques as surely as it controls the rest of the means of production. The worker must be permitted only to perform certain specific narrow tasks as planned by management. Arranged alphabetically by author or source: D[edit] Much is said about scientific management of work. It is a narrow view which restricts the science which secures efficiency of operation to movements of the muscles. The chief opportunity for science is the discovery of the relations of a man to his work â€" including his relations to others who take part â€" which will enlist his intelligent interest in what he is doing. Efficiency in production often demands division of labor. But it is reduced to mechanical routine unless workers see the technical, intellectual, and social relationships involved in what they do, and engage in their work because of the motivation furnished by such perceptions. The tendency to reduce such things as efficiency of activity and scientific management to purely technical externals is evidence of the one-sided stimulation of thought given to those in control of industry â€" those who supply its aims. Because of their lack of all-round and well-balanced social interest, there is not sufficient stimulus for attention to the human factors and relationships in industry. Intelligence is narrowed to the factors concerned with technical production and marketing of goods. No doubt, a very acute and intense intelligence in these narrow lines can be developed, but the failure to take into account the significant social factors means none the less an absence of mind, and a corresponding distortion of emotional life. John Dewey Democracy and Education, section seven: Implications of Human Association Frederick W. Taylor was the first man in recorded history who deemed work deserving of systematic observation and study. Taylor, though the Isaac Newton or perhaps the Archimedes of the science of work, laid only first foundations, however. Not much has been added to them since â€" even though he has been dead all of sixty years. Peter Drucker Management: In the following years of world war, reconstruction, and adjustment, scientific management attracted a new generation of advocates and practitioners, many of whom would have perplexed and shocked Taylor and his immediate circle. Of the entrepreneurs of scientific management who succeeded Frank Gilbreth , Harrington Emerson , Richard Feiss, and other pioneers, none was more successful than Charles Eugene Bedaux Secretive to a fault, he avoided professional contacts, refused to write for popular or technical journals, and spurned publicity. Yet he was a master salesman whose operations were global in scope and impact. Only in recent years, with the discovery of the papers of the British Bedaux Company, is it possible to gauge the impact of Bedaux and his extraordinary career. Steven Kreis, "The diffusion of scientific management: Scientific Management and Taylor M[edit] In the most advanced areas of this civilization, the social controls have been introjected to the point where even individual protest is affected at its roots The manifold processes of introjection seem to be ossified in almost mechanical reactions. The result is, not adjustment but mimesis: The loss of this dimension, in which the power of negative thinkingâ€"the critical power of Reasonâ€"is at home, is the ideological counterpart to the very material process in which advanced industrial society silences and reconciles the opposition Herbert Marcuse One-Dimensional Man. They never realized that human toil was the last thing in the world you had to be efficient about; the only way to be really efficient is to eliminate it entirely, and this would have been heresy to any of the Taylor, Gant, Barth, Cook efficiency crowd. It is sad to contemplate that men of the technical ability of the names mentioned in this paragraph were so lame in their thinking and social outlook that they missed the boat so completely. Who in hell wants to be efficient with a shovel, and what sense would there be even if you succeeded? They should have had their heads opened with a shovel, it might have been more effective. Howard Scott "History and Purpose of Technocracy" in: Northwest Technocrat July

T[edit] In the past the man has been first; in the future the system must be first. This in no sense, however, implies that great men are not needed. On the contrary, the first object of any good system must be that of developing first-class men. Industrial capitalism was running up against renewed resistance from the growing ranks of labor, still committed to a sense of work integrity and craftsmanship. John Zerzan , Elements of Refusal , p. As the Taylor Society admitted with surprising candor, scientific management was widely seen as "the degradation of workmen into obedient oxen under the direction of a small body of expertsâ€"into men debarred from creative participation in their work. John Zerzan , Elements of Refusal , pp.

Chapter 7 : Scientific management - Wikiquote

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But in the 19th century, the infrastructure was put in place for homegrown American science and engineering. Follow along as msnbc. Benjamin Franklin experiments with electricity Henry S. Some accounts claim that Franklin actually went out with a kite and a key in the early s to verify that lighting was electrical in nature. Others say that part of the story is apocryphal. Joseph Henry keeps electric buzz alive NOAA Joseph Henry was a 19th-century scientist whose life parallels that of the English physicist Michael Faraday, who is often credited for discoveries that Henry made too. Faraday made the same discovery at the same time, published, and generally gets the credit for the feat. Rothenberg noted that Henry also invented the first electric motor and became the first secretary of the Smithsonian Institution in , a role in which he fostered the communication of science to the public. Othniel Charles Marsh digs a course for U. He published widely on everything from fossil horses and toothed birds to a gaggle of dinosaurs. He and his students, working on fruit flies in what was known as the "Fly Room," mapped the first genes and linked heredity with chromosomes. Hunt received the Nobel Prize for his work in Edwin Hubble observes that the universe is expanding NASA Starting in the s, some of the largest telescopes in the world were constructed in the U. Some of the greatest discoveries belong to Edwin Hubble, who spent his time observing the stars at the Mount Wilson Observatory in California. In the s, for example, Hubble discovered that the Milky Way is just one of many, many galaxies, an observation that forever changed how astronomers view our place in the universe. Then, in , Hubble announced that the universe is expanding, based on observations of starlight from distant galaxies. The finding formed the basis of inflationary big-bang theory. Key players beginning in the s include the U. The Internet is "transformative in a way that nothing else, perhaps, has ever been," Rothenberg noted. Today, anyone can walk into a library like the one shown here and access the global network. The discovery of a 4. Ardi lived in woodlands and climbed on all fours in the trees, but was also capable walking on two feet â€" suggesting that this hallmark of human evolution occurred in the forest, not grasslands as previously believed. Such findings have brought scientists closer to identifying the common ancestors of chimpanzees and humans.

Chapter 8 : The Unlikely Triumph of Dinosaurs - Scientific American

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Walt Disney took a keen liking to it after being introduced to such by Deems Taylor and Leopold Stokowski. Nebulae and dinosaurs are no longer limited to museum halls and bookshelves when the Disney artists bring their imagination to these subjects. In essence, the sequence would be an artistic impression of evolution. Great care would need to be taken to depict dinosaurs and swirling nebulae onscreen. Both Walt Disney and Hubble would spend core years of their childhood on farms in Missouri, Hubble near the town of Marshfield in the south, Walt near Marceline some two hundred miles to the north. In this region, as Hubble biographer Gale E. One variety was called Wolf River apples, and they were so big that people came from miles around to see them. Both would come to revel in their existence in such a place, and both would ultimately find such cut short, as their families packed up and moved on. Though this similarity of origin is of interest, it was more than likely not discussed when the two giants met. It does however make a fine case for the positive effects of a wholesome Midwestern upbringing. Such acquaintances included the likes of Leopold Stokowski and Igor Stravinsky. Walt would eventually reject his script treatments, part of a long and drawn out development of the story. Connections abound as was common in the collaborative and social mecca of Hollywood. As historian Brian Sibley would explain: Walt had wanted to create the impression of endless space, but it would have been impossible to animate the number of stars, so the department had to come up with something clever. Behind the model earth was a dark screen that was punctuated with small holes that were illuminated from behind. Julian would carry this study into the twentieth century, expanding on the original discoveries of Charles Darwin. If such a noted scientist as Gould can explicitly trace his career aspirations to Rite of Spring, we can only think of countless more scientists of all kinds, from paleontologists to astronomers, who have likewise been influenced. This is perhaps the greatest legacy of Rite of Spring, a deep practical influence on future generations. There is more to the timelessness of Disney cinema than pure narrative or fairy tale inspiration. Stephen Jay Gould Photo Source: The filmmakers of Fantasia, however, were certainly conscious of the delicate socio-political arena they were entering when evolution is involved. John Culhane thoroughly explains: Disney thereupon decided that Fantasia might have enough trouble getting accepted by the general public- as indeed it did- without courting a creationist boycott. A Space Odyssey, in more than just its depictions of space, but also that of prehistoric humans. More than likely the answer is no. He did however, have a strong artistic agenda. Walt Disney was not a scientist. We could have a battle and build it to a grand climax. It is the fight for life. But Walt, like many scientists, was also a visionary, with his mind always thinking to the future. Rite of Spring, however, remains the wholly artistic piece in its presentation. The practical inspiration would come as a product of the film. Rite of Spring does not spew scientific fact in an expository manner; rather it adapts them for artistic expression. Spurred on by the music of Stravinsky, and studies of those like Hubble and Huxley, they gifted many a viewer with their first view of the cosmos, their first view of our little planet in the vastness of space. Today, with the gifts of the Hubble Space Telescope, we can almost take for granted such a view. But no one could have in , when such a thing had never been gifted before. Yet another of many gifts which we must thank Walt Disney and his artists for. Walt Disney Family Foundation, Mariner of the Nebulae. U of Chicago, Imaging Space and Time. National Geographic Society, Brian Sibley, Audio Commentary. Walt Disney Studio, Reflections in Natural History.

Chapter 9 : Charles Darwin: A Life of Discovery | Angus Carroll's Blog

New Cystic Fibrosis Medication a Triumph of Drug Discovery. Getting a drug from conception to market is among the riskiest, hardest and most expensive of scientific and human endeavors, often.