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Atomic theory scientists and their contributions pdf

Aristotle did not believe the ancient Greek theory of atoms of different sizes, regular geometric shapes and beig in constant motion. He did not think that atoms could be in constant motion in the void. He developed a name that all matter consisted of four elements: Earth, Air, Water and Fire. There were also four qualities: dryness, composure, cold and humidity. The fire was dry and hot, the water was wet and cold, etc. Each of these elements naturally moved in a row to its right place where it would be at rest. Aristotle's theory also had two powers: conflict and harmony. It was believed that conflict causes bad things, and harmony is good things. Aristotle also believed that the heavens were made of the fifth, superb element called aither. Aristotle's theory was used for almost 2,000 years until after the scientific revolution, when other theories prevailed - Model for understanding elementary particles Atomic model redirects here. For an unrelated term in mathematical logic, see this article about historical models of the atom. For the history of studying how atoms combine into molecules, see for the modern view of an atom that has evolved from atomic theory, see atomic physics. The current theoretical model of the atom includes a dense nucleus surrounded by a probabilistic cloud of electrons Atomic theory is a scientific theory that matter consists of particles called atoms. Atomic theory originates in an ancient philosophical tradition known as atomism. According to this idea, if you take a piece of matter and cut it into smaller pieces, you could reach a point where the pieces cannot be further cut into anything less. Ancient Greek philosophers called these hypothetical finite particles of matter atoms, a word that meant uncircumcised. In the early 1800s, scientist John Dalton noticed that chemicals appeared to combine and break into other substances by weight in proportions that indicated that matter really made up of atoms, as ancient philosophers suspected. Shortly after 1850, some physicists developed a kinetic theory of gases and heat that mathematically simulated the behavior of gases, suggesting that the gases were made of particles. In the early 20th century, Albert Einstein and Jean Perrin proved that the brouian movement (the unstable movement of pollen grains in water) is caused by the action of water molecules - this third line of evidence has drowned out the remaining doubts of scientists as to whether atoms and molecules are real. Throughout the nineteenth century, some scientists warned that the evidence for atoms is circumstantial, and so atoms may not be real, but only seem real. By the beginning of the 20th century, scientists sufficiently detailed and accurate models of the structure of matter, which led to more strictly defined classifications of tiny invisible particles that make up ordinary matter. The atom is now defined as the main particle that makes up the chemical element. At the turn of the 20th century, physicists discovered that particles that chemists called atoms were actually agglomerations of even smaller particles (subatomic particles), but scientists kept the name out of convention. The term elementary particle is currently used to refer to particles that are actually indivisable. History of Philosophical Atomism Main article: Atomism The idea that matter consists of discrete units is a very old idea, appearing in many ancient cultures such as Greece and India. The word atom (Greek: ἄτομος; atomos), meaning uncircumcised, was coined by the pre-zocratic Greek philosophers Leicippus and his disciple Democritus (c.460-c.370 BC). Democrit taught that atoms are infinite in number, non-creative and eternal, and that the qualities of an object are the result of the type of atoms that make up it. The Atomism of Democrit was perfected and developed by the later Greek philosopher Epicurus (341-270 BC) and the Roman Epicurean poet Lucretius (c.99-55 BC). In the early Middle Ages, atomism was largely forgotten in Western Europe.During the 12th century, atomism became known again in Western Europe thanks to references to it in the newly discovered works of Aristotle. In the 14th century, the revival of major works describing atomic teachings, including Lucretia's De Rerum Nature and Diogenes Laartius's Life and Opinions, led to increased scientific attention to the issue. However, since atomism was associated with the philosophy of epicureanism, contrary to orthodox Christian teachings, belief in atoms was not considered acceptable by most European philosophers. The French Catholic priest Pierre Gassendi (1592-1655) revived the Epicurean atomism with modifications, claiming that the atoms were created by God and, although extremely numerous, not infinite and the first person to use the term molecule to describe the totality of the atom. The modified theory of Gassendi atoms was popularized in France by the physician Francois Bernier (1620-1688) and in England by the natural philosopher Walter Charlton (1619-1707). Chemist Robert Boyle (1627-1691) and physicist Isaac Newton (1642-1727) defended atomism, and by the end of the 17th century it was accepted by part of the scientific community. John Dalton Closer to the end of the 18th century there were two laws on chemical reactions, without referring to the concept of atomic theory. The first was the law of preservation of the masses, closely related to the work of Antoine Lavoisier, which states that the total mass in the chemical reaction remains constant (i.e. the reaction mass has the same mass as the products). The second was the law of certain proportions. First created by The French chemist Joseph Proust in 1797, this law states that if the compound is broken into composite chemical elements, the masses of the constituents will always have the same proportions in weight, regardless of the quantity or source of the original substance. John Dalton studied and expanded this previous work and defended the new idea, later known as the law of several proportions: if the same two elements can be combined to form a series of different compounds, the ratios of the masses of the two elements in their different compounds will be represented by small numbers. This is a common pattern in chemical reactions observed by Dalton and other chemists at the time. Example 1 - tin oxides: Dalton identified two tin oxides. One is a gray powder, which has 13.5 parts of oxygen for every 100 parts of the tin. The other oxide is a white powder with 27 parts of oxygen for every 100 parts of the tin. 13.5 and 27 form a 1:2 ratio. These oxides are today known as tin oxide (II) (SnO) and tin oxide (IV) (SnO_2) respectively. Example 2 - iron oxides: Dalton identified two iron oxides. One is black powder, which for every 100 parts of iron has about 28 parts of oxygen. Another red powder, which for every 100 parts of iron has 42 parts of oxygen. 28 and 42 form a 2:3 ratio. These oxides are today known as iron oxide (II) (better known as wustyte) and iron oxide (III) (the main component of rust). Their Formula FeO and Fe_2O_3 respectively. Example 3 - nitrogen oxides: there are three nitrogen oxides, which for every 140 grams of nitrogen, there is 80 g, 160 g and 320 grams of oxygen respectively, which gives a ratio of 1:2:4. These are nitrous oxide (N_2O), nitrous oxide (NO) and nitrogen dioxide (NO_2) respectively. This repetitive pattern indicates that chemicals react not in an arbitrary amount, but in multiples of some basic indivisib unit of mass. In his writings, Dalton used the term atom to refer to the main particle of any chemical, not just the elements, as is practiced today. Dalton did not use the word molecule; instead he used the terms complex atom and elementary atom. Dalton believed that atomic theory could also explain why water absorbs different gases in different proportions - for example, he found that water absorbs carbon dioxide much better than it absorbs nitrogen. Dalton suggested that this was due to differences in the mass and complexity of the corresponding gas particles. Indeed, carbon dioxide (CO_2) molecules are heavier and larger than nitrogen molecules (N_2). Dalton suggested that every chemical element atoms of one unique type, and although they cannot be altered or destroyed by chemical means, they can be combined into more complex structures (chemical compounds). This marked the first truly scientific theory of the atom, as Dalton came to his conclusions by experimenting and studying the results in an empirical way. Different atoms and molecules, as pictured in the new system of chemical philosophy john Dalton (1808). In 1803, Dalton orally presented his first list of relative atomic scales for a number of substances. This article was published in 1805, but he did not discuss there exactly how he got these figures. The method was first shown in 1807 by his friend Thomas Thomson in the third edition of Thomson's chemistry textbook. Finally, Dalton published the full report in his own textbook, the New Chemical Philosophy System, 1808 and 1810. Dalton estimated atomic weights according to the ratio of the masses in which they combined to the hydrogen atom taken as unity. However, Dalton did not think that with some elements atoms exist in molecules, for example, pure oxygen exists as O_2. He also mistakenly believed that the simplest connection between any two elements was always one atom of each (so he thought the water was HO, not H_2O). This, in addition to the crudity of its equipment, is flawed by its results. For example, in 1803, he believed that oxygen atoms were 5.5 times heavier than hydrogen atoms because in water he measured 5.5 grams of oxygen for every 1 gram of hydrogen and believed that the water formula was HO. Taking the best data, in 1806 he came to the conclusion that the atomic weight of oxygen should actually be 7, not 5.5, and he kept that weight for the rest of his life. Others at this time have already concluded that the oxygen atom should weigh 8 relative to the hydrogen equals 1, if one takes the Dalton formula for the water molecule (HO), or 16 if one takes the modern water formula (H_2O). Avogadro The flaw of Dalton's theory was corrected in principle in 1811 by Amedeo Avogadro. Avogadro suggested that equal volumes of any two gases at the same temperature and pressure contain an equal number of molecules (in other words, the mass of gas particles does not affect the volume it occupies). Avogadro's law allowed him to deduce the diatomical nature of numerous gases by studying the volumes to which they reacted. For example: since two litres of hydrogen would react with only one liter of oxygen to produce two litres of water vapor (at constant pressure and temperature), this meant that one oxygen molecule splits in two to form two water particles. Thus, Avogadro was able to offer more accurate estimates of the atomic mass of oxygen and various other elements, and made a clear distinction between molecules and atoms. The Bronx Movement in 1827, a British botanist noted that dust particles inside the pollen grains floating in the water are constantly jiggled about for no apparent reason. In 1905, Albert Einstein predicted that this brouian movement was caused by water molecules constantly banging on grains, and developed a hypothetical mathematical model to describe it. This model was experimentally confirmed in 1908 by French physicist Gene Perrin, thus providing additional testing of particle theory (and atomic expansion theory). The discovery of subatomic particles Main articles: The electronic and plum pattern of pudding Cathode rays (blue) were emitted from the cathode, sharpened to a beam by crevices, and then deflected as they passed between two electrified plates. Atoms were considered the smallest possible division of matter until 1897, when J.J. Thomson discovered the electron through his work on cathode rays. The Crookes tube is a sealed glass container in which two electrodes are separated by a vacuum. When the voltage is applied through the electrodes, the cathode rays are generated, creating a glowing area where they hit the glass at the opposite end of the tube. As a result of the experiments, Thomson discovered that the rays could deviate by an electric field (in addition to magnetic fields that were already known). He concluded that these rays, not the shape of light, consist of very light negatively charged particles, which he called corpuscles (later they will be renamed by other scientists as electrons). He measured the mass-to-charge ratio and found that it was 1,800 times smaller than that of hydrogen, the smallest atom. These calves were a particle unlike any other previously known. Thomson suggested that atoms are divided, and that calves were their building blocks. To explain the overall neutral charge of the atom, he assumed that the calves were distributed in a single sea of positive charge; it was a model of plum pudding, as the electrons were embedded in a positive charge, like raisins in plum pudding (although in Thomson's model they were not stationary). Discovery of the Core Home article: Rutherford Model Geiger-Marsden Experiment Left: Expected Results: Alpha Particles Passing Through plum pudding models of an atom with a slight deviation. Right: Observed results: A small part of the particles was rejected by a concentrated positive charge of the nucleus. Thomson's plum pudding model was disproved in 1909 by one of his former students, Ernest Rutherford, who discovered that much of the mass and positive charge of the atom was concentrated in a very small part of its volume, which he assumed was in the center. Ernest Rutherford and his colleagues Hans Geiger and Ernest Marsden raised doubts about the Thomson model after they ran into difficulties when they tried to build a tool for the ratio of charge to the mass of alpha particles (these are positively charged particles emitted by certain radioactive substances, such as radium). Alpha particles were scattered through the air in the detection chamber, making the measurements unreliable. Thomson faced a similar problem in his work on cathode beams, which he solved by creating a near-perfect vacuum in his instruments. Rutherford didn't think it would work in the same problem because alpha particles are much heavier than electrons. According to Thomson's atom model, the positive charge in the atom is not concentrated enough to produce an electric field strong enough to deflect the alpha particle, and the electrons are so light that they should be easily pushed aside by much heavier alpha particles. However, there was a scattering, so Rutherford and his colleagues decided to thoroughly investigate this scattering. Between 1908 and 1913, Rateford and his colleagues conducted a series of experiments in which they filled with alpha particles of fine metal foil. They noticed alpha particles deflected by angles more than 90 degrees. To explain this, Rutherford suggested that the positive charge of the atom is not distributed by the volume of the atom, as Thomson believed, but is concentrated in a tiny nucleus in the center. Only such an intense charge concentration can produce an electric field strong enough to deflect alpha particles as observed. The first steps to the quantum physical model of the atom Home article: Bor model of the Planetary model of the atom had two significant flaws. First, unlike planets orbiting the Sun, electrons are charged particles. Acceleration of electric charge is known to emit electromagnetic waves in accordance with the Larmor formula in classical electromagnetism. The orbital charge must constantly lose energy and spiral to the nucleus, colliding with it in a small fraction of a second. The second problem was that the planetary model could not explain the observed high-peak emission and absorption of atoms. The Bora model of quantum theory of the atom revolutionized physics in the early 20th century, when Max Planck and Albert Einstein postulated that light energy was emitted or absorbed in discrete quantities known as quanta (singular, quantum). In 1913, Niels Bohr incorporated this idea into his model of the Bora atom, in which the electron could only rotate around the nucleus, in particular circular orbits with fixed angular momentum and energy, its distance from the nucleus (i.e. their radii), proportional to its energy. According to this model, the electron could not spiral into the nucleus because it could not lose energy in a continuous manner; instead, it can only make instant quantum jumps between fixed energy levels. When this happened, the light was or is absorbed at a frequency proportional to the change in energy (hence the absorption and radiation of light in discrete spectrums). Bora's model wasn't perfect. He could only predict the spectral lines of hydrogen; it could not have predicted those of multielectronic atoms. To make matters worse, as spectrograph technology improved, there were additional spectral lines of hydrogen that the Bora model could not explain. In 1916, Arnold Sommerfeld added elliptical orbits to the Bora model to explain the additional emission lines, but this made the model very difficult to use, and it still could not explain the more complex atoms. Discovery isotopes Main article: Isotope During experiments with the products of radioactive decay, in 1913 radiochemist Frederic Soddy found that there appears to be more than one element in each position on the periodic table. The term isotope was coined by Margaret Todd as a suitable name for these elements. In the same year, J.J. Thomson conducted an experiment in which he directs a stream of neon ions through magnetic and electric fields, striking a photographic plate at the other end. He noticed two glowing spots on the plate that suggested two different trajectories of deviation. Thomson concluded that this was because some of the neon ions had a different mass. The nature of this different mass will later be explained by the discovery of neutrons in 1932. The discovery of nuclear particles Main Articles: Atomic Nucleus and The Discovery of a Neutron In 1917 Rutherford bombarded nitrogen gas with alpha particles and watched as hydrogen nuclei were ejected from gas (Rutherford recognized them because he had previously received their hydrogen bombardment with alpha particles, and the observation of hydrogen nuclei in products). Rutherford concluded that the hydrogen nuclei came out of the nuclei of nitrogen atoms themselves (in fact, it split nitrogen). From his own work and the work of his disciples Bohr and Henry Moseley, Rutherford knew that the positive charge of any atom could always be equated to a larger number of hydrogen nuclei. This, combined with the atomic mass of many elements roughly equivalent to the number of hydrogen atoms that were then supposed to be the lightest particles, led it to conclude that hydrogen nuclei are the only particles and the main component of all atomic nuclei. He called these particles protons. Further Rutherford experiments showed that the nuclear mass of most atoms exceeded the mass of the protons it possessed; he suggested that this excess mass was made up of previously unknown neutrally charged particles, which were previously called neutrons. In 1928, Walter Bote noticed that beryllium emitted high penetrating, electrically neutral radiation when bombardment by alpha particles. It was later discovered that this radiation could bring down hydrogen paraffin wax. It was originally thought to be high energy gamma radiation, as gamma radiation had a similar effect on electrons in metals, but James Chadwick found that the ionization effect was too strong to be due to electromagnetic radiation, as long as energy and pulse were stored in interaction. In 1932, Chadwick exposed various elements, such as hydrogen and nitrogen, to the mysterious beryllium radiation, and by measuring the energy of recoiling charged particles, he concluded that radiation actually consists of electrically neutral particles that cannot be as moisture-free as a gamma ray, but instead should have a mass similar to a proton mass. Chadwick has now claimed that these particles are Rutherford neutrons. For the discovery of the neutron, Chadwick won the Nobel Prize in 1935. The quantum physical models of the atom Main article: Atomic Orbital Five filled atomic orbits of a neon atom are separated and arranged in order of increasing energy from left to right, with the last three orbits equal in energy. Each orbit holds up to two electrons, which most likely exist in areas represented by colored bubbles. Each electron is equally present in both orbital zones, shown here by color only to highlight a different phase of the wave. In 1924, Louis de Brogley suggested that all moving particles, especially subatomic particles such as electrons, should exhibit a certain degree of wave preparation. Erwin Schroedinger, fascinated by this idea, explored whether it was better to explain the movement of an electron in an atom as a wave rather than as a particle. Schroedinger's equation, published in 1926, describes the electron as a wave function, not as a tone particle. This approach elegantly predicted many spectral phenomena that the Bora model could not explain. Although this concept was mathematically convenient, it was difficult to visualize and she faced opposition. One of his critics, Max Bourne, suggested instead that Schroedinger's wave function described not an electron, but all its possible states, and thus could be used to calculate the probability of finding an electron anywhere around the nucleus. This reconciled two opposing theories of particles and wave electrons, and the idea of duality of wave particles was introduced. This theory states that an electron can exhibit the properties of both waves and particles. For example, it can be refracted like a wave, and has a mass like a particle. The consequence of describing electrons as wave forms is that it is mathematically impossible to simultaneously obtain the position and pulse of an electron. This became known as the Heisenberg Uncertainty Principle after the theoretical physicist Werner Heisenberg, who first described it and published it in 1927. It's not valid. model, with its neat, well-defined circular orbits. The modern model of the atom describes the position of electrons in the atom in terms of probability. An electron can potentially be found at any distance from the nucleus, but depending on its energy level, there are more common in some regions around the nucleus than others; this model is called atomic orbital. Orbits come in a variety of form spheres, dumbbells, tors, etc. - with a core in the middle. See also the physical portal Spectroscopy History of Molecular Theory Timeline of the discoveries of chemical elements Introduction to quantum mechanics Kinetic Gas Theory Atomism Physical Principles of quantum Footnote Theory - Pullman, Bernard (1998). An atom in the history of human thought. Oxford, England: Oxford University Publishing House. 31-33. ISBN 978-0-19-515040-7.CS1 maint: ref'harv (link) - b Kenny, Anthony (2004). Ancient philosophy. A new history of Western philosophy. 1. Oxford, England: Oxford University Publishing House. 26-28. ISBN 0-19-875273-3.CS1 maint: ref'harv (link) - b c d e f g Pyle, Andrew (2010). Atoms and atomism. In Grafton, Anthony; Majority, Glenn W.; Settis, Salvatore (d.e.). It's a classic tradition. Cambridge, Massachusetts and London, England: Belknap Press Harvard University Press. 103-104. 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