ATTEMPT TOWARDS A CHEMICAL CONCEPTION OF THE ETHER pdf

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D. MENDELEEF. Aether. An Attempt Towards A Chemical Conception Of The Ether A Chemical Conception Of The Ether. by. of all gases and a tendency in them.

Figures 2 and 3 , preceded by two partial periods of seven elements each lithium to fluorine and sodium to chlorine ,â€¦ Early life and education Mendeleev was born in the small Siberian town of Tobolsk as the last of 14 surviving children or 13, depending on the source of Ivan Pavlovich Mendeleev, a teacher at the local gymnasium, and Mariya Dmitriyevna Kornileva. To support the family, his mother turned to operating a small glass factory owned by her family in a nearby town. Petersburg , where he enrolled in the Main Pedagogical Institute. His mother died soon after, and Mendeleev graduated in He got his first teaching position at Simferopol in Crimea. He stayed there only two months and, after a short time at the lyceum of Odessa , decided to go back to St. Petersburg to continue his education. Financed by a government fellowship, he went to study abroad for two years at the University of Heidelberg. In September he attended the International Chemistry Congress in Karlsruhe , convened to discuss such crucial issues as atomic weight s, chemical symbol s, and chemical formula s. In later years Mendeleev would especially remember a paper circulated by the Italian chemist Stanislao Cannizzaro that clarified the notion of atomic weights. In Mendeleev returned to St. Petersburg, where he obtained a professorship at the Technological Institute in After the defense of his doctoral dissertation in he was appointed professor of chemical technology at the University of St. He became professor of general chemistry in and continued to teach there until Formulation of the periodic law As he began to teach inorganic chemistry, Mendeleev could not find a textbook that met his needs. Since he had already published a textbook on organic chemistry in that had been awarded the prestigious Demidov Prize, he set out to write another one. The result was Osnovy khimii â€”71; The Principles of Chemistry , which became a classic, running through many editions and many translations. When Mendeleev began to compose the chapter on the halogen element s chlorine and its analogs at the end of the first volume, he compared the properties of this group of elements to those of the group of alkali metal s such as sodium. Within these two groups of dissimilar elements, he discovered similarities in the progression of atomic weights, and he wondered if other groups of elements exhibited similar properties. After studying the alkaline earth s, Mendeleev established that the order of atomic weights could be used not only to arrange the elements within each group but also to arrange the groups themselves. Thus, in his effort to make sense of the extensive knowledge that already existed of the chemical and physical properties of the chemical elements and their compounds , Mendeleev discovered the periodic law. He had such faith in the validity of the periodic law that he proposed changes to the generally accepted values for the atomic weight of a few elements and predicted the locations within the table of unknown elements together with their properties. At first the periodic system did not raise interest among chemists. However, with the discovery of the predicted elements, notably gallium in , scandium in , and germanium in , it began to win wide acceptance. Gradually the periodic law and table became the framework for a great part of chemical theory. By the time Mendeleev died in , he enjoyed international recognition and had received distinctions and awards from many countries. Other scientific achievements Since Mendeleev is best known today as the discoverer of the periodic law , his chemical career is often viewed as a long process of maturation of his main discovery. In this account, Mendeleev mentioned the Karlsruhe congress as the major event that led him to the discovery of the relations between atomic weight s and chemical properties. First, in the field of chemical science , Mendeleev made various contributions. In the field of physical chemistry , for instance, he conducted a broad research program throughout his career that focused on gases and liquids. In he formulated a theory subsequently discredited that solutions are chemical combinations in fixed proportions. In the s he studied the thermal expansion of liquids. From the beginning of his career, he continually sought to shape a broad theoretical scheme in the tradition of natural philosophy. All his efforts were not equally successful. With the discovery of electron s and radioactivity in the s, Mendeleev perceived a threat to his theory of the individuality of elements. In Popytka khimicheskogo ponimania mirovogo efira ; An Attempt Towards a Chemical Conception of the Ether , he explained these phenomena as

movements of ether around heavy atoms, and he tried to classify ether as a chemical element above the group of inert gases or noble gas es. Activities outside the laboratory Mendeleev carried on many other activities outside academic research and teaching. He was one of the founders of the Russian Chemical Society now the Mendeleev Russian Chemical Society in and published most of his later papers in its journal. He was a prolific thinker and writer. His published works include books and articles, and numerous unpublished manuscripts are kept to this day in the Dmitri Mendeleev Museum and Archives at St. In addition, in order to earn money he started writing articles on popular science and technology for journals and encyclopaedias as early as Another interest, that of developing the agricultural and industrial resources of Russia , began to occupy Mendeleev in the s and grew to become one of his major preoccupations. He wrote projects to develop a coal industry in the Donets Basin , and he traveled to both Baku in Azerbaijan then part of the Russian Empire and to Pennsylvania in the United States in order to learn more about the petroleum industry. All told, he may have devoted more time to questions of national economy than to pure chemistry. However, it seems he developed a metaphysics of his own through his daily experience. In the s the visit of a famous medium to St. He first acted as a government consultant until he was appointed director of the Central Bureau of Weights and Measures, created in There he made significant contributions to metrology. Refusing to content himself solely with the managerial aspect of his position which involved the renewal of the prototypes of length and weight and the determination of standards , he purchased expensive precision instruments, enlarged the team of the bureau, and conducted extensive research on metrology. After a few years he published an independent journal of metrology. Thus, Mendeleev was able to combine his lifetime interests in science and industry and to achieve one of his main goals:

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In Dmitri Mendeleev: Other scientific achievements khimicheskogo ponimania mirovogo efira (; An Attempt Towards a Chemical Conception of the Ether), he explained these phenomena as movements of ether around heavy atoms, and he tried to classify ether as a chemical element above the group of inert gases (or noble gases).

Print Advertisement THE ether is usually defined as an imponderable elastic fluid, permeating all bodies and all space. But it must have weight, or mass, if it is matter. Lord Kelvin has computed a minimal mass of 10â€”grammes per cubic meter. Ether cannot be a mixture of ordinary gases, for these do not penetrate all substances, and they act differently upon those they do penetrate, whereas ether is everywhere the same. Many learned men suggest or express belief in ether as the primordial matter of which atoms are formed, and in which they float just as stars and planets co-exist with un- agglomerated cosmical dust. Some think that atoms are continually being formed and disintegrating, others that they were created once for all and that the ether is a residue or by-product of their formation. With the latter hypothesis, which rests on pure assumption, realists have nothing to do. The former involves the possibilityâ€”long accepted by the great mass of mankindâ€”of creating new atoms and annihilating matter. Emmens has claimed that he can make gold from silver, Fittica that he can convert phosphorus into arsenic. Many such transformations were described half a century ago, but every one was based on errors due to inadvertence or prejudice. If we had to do merely with the ether that fills the interplanetary space and conveys energy through it, we could confine our attention to the mass and neglect the chemical nature of the ether. But so negative and bloodless an ether becomes unsatisfactory when we descend from heaven to earth, for the ether must permeate all bodies. This power of penetration may be regarded as the highest development of the power of diffusion, shown by many gases with respect to caoutchouc, and by hydrogen with respect to iron, palladium, and platinum. But the power of ether to form true compounds must be absolutely nil; in permeating othsr substances the only change it can undergo is a certain condensation. Ten years ago the existence of so inert a substance appeared improbable, but now we know five such, argon, helium, neon, krypton, and xenon, the gases discovered by Ramsay and his associates; which dissolve freely in water, but so far as is known, form no definite compounds with anything. They afford an experimental basis for the conception of ether as a gas incapable of combination. We need not, like Crookes, assume a fourth state of aggregation, and thus we avoid all mysticism. We have assumed nothing inconsistent with the current conception of ether. In , when I pointed out the periodic connection between the properties of the elements and their atomic weights, the existence of absolutely inert elements was not suspected. Therefore the system began with group I and series I, or with hydrogen, the lightest known element, common to both, but I never thought that it must begin with hydrogen. My predictions of the existence and properties of unknown elements were confirmed by the discoveries of gallium, scandium, and germanium. These predictions are examples of what mathematicians call interpolation. The prediction of ether, as a rare gas, is an example of extrapolation which I venture now to attempt, because I have little time to wait, and because the new theory that atoms are composed of much smaller electrons appears to me to have sprung from the want of a definite conception of the ether, an outrush of which will suffice to explain the apparent disintegration of atoms into electrons. The periodic system may be illustrated by an example. If we arrange in two series those elements whose atomic weights lie between 7 and Hence the vertical groups are designated by the Roman numerals I. But as the new gases form no compounds, they must be put in a zero group, and the atomic weight of each must fall between those of an element of group VII. This a priori conclusion is fully confirmed by experiment as appears from the following table, which is extended to include group zero and series zero and two hypothetical elements, x and y. The latter, y, must have the fundamental properties of the argon group. If it is monatomic, like the helium group, its density is half its atomic weight, or less than 0. Unity of a higher order is given by the conception of ether as the final link in the chain of elements. The molecular velocity of a gas may be calculated from the kinetic theory. For hydrogen at 0 deg. For any gas at temperaturo mates of the temperature of space lie bet ween â€”60 deg. Taking the mean, â€”80 deg. All WI Gases heavier than this would remain attached to the earth; lighter ones would escape. But ether atoms must

be still lighter and swifter to escape the attraction of still larger suns. The masses of some binary stars have been computed from their rotations. The heaviest has 33 times the mass of the sun. There is spectroscopic and other evidence that their densities do not differ greatly from his. This is about of the velocity of light, ,, meters per second, and we may assume the molecular velocity of ether to lie between these limits. The corresponding limits for its atomic weight are 0. In the present state of science it seems impossible to accept the latter value, which would suggest a return to the emission theory of light. I think that many phenomena may be explained by assuming that the x atoms have about a millionth of the mass of hydrogen atoms and a mean velocity of nearly two and a quarter millions of meters per second. While I was making these calculations, I received Prof. It is but a step from this to the assumption of a still lighter gas filling all space and giving a tangible reality to the conception of the ether. Without developing the theory further I turn to certain apparently irrelevant phenomena which have guided my speculations, led me to publish this essay, and induced others to revert to the emission theory or to adopt that of electrons, scarcely conceivable to me, without thereby clarifying our conception of the ether. I refer especially to radio-activity. From the first my impression has been that here we have to do with a condition which is no more peculiar to uranium, thorium, and radium than magnetism is to iron, cobalt, and nickel. These heaviest of all atoms V , Th , Rd may be regarded as suns possessing the highest development of that special attractive power which is intermediate between gravitation and chernism, and which is the cause of gas absorption, solution and the like. We must not assume that because ether, like argon, forms no staple compounds, it may not dissolves in accumulate about great centers of attraction such as stars and suns, uranium and thorium atoms. Thoughsuch accumulation might involve a change in velocity, it would be a comet-like rather than a planet-like connection, and it would be most likely to occur with the heavy uranium and thorium and radium atoms. Such an ether swarm about the uranium atom would explain various phenomena. I believe that radioactivity indicates a material emanation and that the arrival and departure of ether atoms are accompanied by the disturbances which constitute waves of light. When a flask containing gelatinous zinc sulphide is connected by a tube with a flask of radio-active solution, the sulphide glows as long as the connection is maintained, but the phosphorescence gradually dies away when the connecting tube is closed, and may be renewed by reopening the stop-cock. This experiment, which M. Curie performed in my presence, becomes explicable if we assume that a tenuous ethereal gas enters and leaves the radioactive substance as comets enter and leave the solar system. Transverse light waves may be provoked either by molecular motion of other bodies, as in incandescence, or by variation in the motion of ether atoms themselves, that is, by a disturbance of their mobile equi- li brium. I think that light waves are far more complex than is generally believed, because of the great velocity of the ether atoms. Dewar has observed that the phosphorescence of parafin and other substances is greatly increased by cooling to â€” deg. It appears to me that at very low temperatures there is a condensation or an increased absorption of ether in these substances and that the increased phosphorescence iii due to motion of ether atoms. This essay is merely a series of impressions, suggested, however, by actual phenomena. Probably others have had similar ideas but have not developed them. If there is any truth in my theory, it will be elaborated and confirmed; if it is wholly false, its refutation will warn others. I have attempted to give the first approximate answer to the question: What is the chemical nature of universal ether? Or, rather, to bring the question before the parliament of science.

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3: An Attempt at a Chemical Conception of Universal Ether - Scientific American

an attempt towards a chemical conception of the ether. an attempt towards a chemical conception of the ether. edward w. morley. j. am. chem. soc.

Their names reflect a variety of influences based on a mix of language, culture, and our understanding of chemistry, according to the BBC. Gold, iron, copper, and silver names all come from Anglo-Saxon roots, but were known to man long before those names came into use. Most of these can be found in nature in their pure states, but even iron, which usually requires smelting to extract it from ore, was used in artifacts dating from B. Meteoric iron was used by humans before smelting of iron ores was invented. The Romans were the first to begin using names for the elements ending with -um, a practice which still continues. For example, niobium was called columbium in the U. The proposed name gets checked to make sure it has never been associated with any other element, in any capacity. Humphry Davy discovered nine elements using electrolysis. Over a quarter of all element names are derived from a place, usually where they were discovered or were first synthesized. About a dozen element names come from myth and legend such as cobalt, titanium, and promethium. No discoverer has ever named an element after himself, but several have been named in honor of famous scientists, like fermium, curium, and einsteinium. Nine elements are named for the brightest color they emit, using spectroscopy, such as indium and rubidium. Others are identified based on smell. Sir Humphry was a little indecisive, though. First, he used the name alumium, in Then he shifted the name to aluminum, and finally, in , settled on aluminium. Antoine Lavoisier established that alumina was an oxide of an unknown metal. The last version was the most popular with his colleagues, for its classical ring, and because of its linguistic consistency with other elements such as potassium, sodium, and magnesium, all of which Davy had also named. Aluminum stayed in use for a little while in Britain, but aluminium quickly became the preferred name. Bar of aluminium Al crystal growth raw material, with visible dendrites on the macroetched surface, from the collection of Ethan Currens. In the first decade of the s, the version ending -um started to become more popular in the States, and by the decade following, -ium was very uncommon to see. The name was officially standardized internationally as aluminium, but in the United States, aluminum persists. Over the last 75 years, new elements have been discovered in laboratory settings by what amounts to spit-balling â€” hurling atomic nuclei at each other with great force, to see what sticks. This has been gradually adding to the sequence of super-heavy elements. As a result, the International Union of Practical and Applied Chemistry has been assigning these elements temporary names, but in truth, most chemists just refer to them by their numbers.

4: Mendeleev's predicted elements - Wikipedia

But, beyond this, the conception of the ether as a limiting state of expansion of vapours and gases cannot sustain even the most elementary analysis, for ether cannot be understood otherwise than as an all-pervading ubiquitous substance, and this is not the property of either gases or vapours. Both.

Moreover, in order to explain the phenomena of light, electricity, and even gravity, this medium is supposed to undergo various disturbances perturbations and changes in its structure deformation , like those observed in solids, liquids and gases. If the fluid medium permeates everything and everywhere, it cannot be said to have weight, just as the ponderability of air could not be recognized before the invention of the air pump. Yet the ether must have weight, because, since the days of Galileo and Newton, the quality of gravitation or of weight forms a primary property of substances. From various considerations Lord Kelvin came to the conclusion that a cubic meter of ether should weigh about and not less than 0. The above-mentioned misgivings of the thoughtful scientist in his most plausible endeavors to ascribe a certain weight or mass to the ether, for the question naturally arises: At what pressure and temperature will this weight be proper to ether? For at infinitely small pressures or exceedingly high temperatures steam or hydrogen would have as small a density as that given by Lord Kelvin for the ether. And as regards the density of the ether in interplanetary space, neither steam nor hydrogen would have a measurable density in these regions, notwithstanding the extreme cold, for the pressure would be infinitely small. Theoretically, space may be supposed to be filled with such rarified residues of vapors and gases. It also accounts for the uniformity of the chemical composition of the entire universe, demonstrated by the spectroscope, as it gives a means, through the agency of such ether, of interchange between the heavenly bodies. One of the objects of an investigation into the elasticity or compressibility of gases under low pressure, undertaken by me in the s, was to trace, as far as the then existing methods of measuring low pressures permitted, the changes proceeding in gases under low pressures. Kirpitchnikoff, for all gases, and subsequently confirmed by Ramsay and others although still denied by some investigators , indicate a certain uniformity in the behavior of all gases and a tendency in them towards a certain limiting expansion at low pressures, just as there is a limit to compression liquefaction and the critical state. But determinations of very low pressures are accompanied by insurmountable difficulties. It proved practically impossible to measure, with any degree of accuracy, pressures under tenths of a millimeter of mercury, and this is far too large a figure for such rarified media as are supposed to exist at an elevation of even 50 kilometers above sea level. Hence the conception of the ether as a highly rarified atmospheric gas cannot so far be subjected to experimental investigation and measurement, which alone can direct the mind in the right direction and lead to reliable results. But, beyond this, the conception of the ether as a limiting state of expansion of vapors and gases cannot sustain even the most elementary analysis, for ether cannot be understood otherwise than as an all-pervading ubiquitous substance, and this is not the property of either gases or vapors. Both the latter are liquefiable under pressure, and cannot be said to permeate all substances, although they are widely distributed in mature, even in meteorites. Moreover -- and this is the most important -- they vary infinitely in their chemical nature and in their relations to other substances, while the ether, as far as is known, is invariable. Owing to the variety of their chemical properties, all vapors and gases should react differently on the bodies which they permeate if they were components of the ether. Before proceeding further, I think it necessary to justify the chemical views here and elsewhere brought into play. In the days of Galileo and Newton it was possible, although difficult, to conceive ether apart from them. But now it would be contrary to the most fundamental principles of natural science, for chemistry, since Lavoisier, Dalton and Avogadro Gerhardt, has acquired the most sacred rights of citizenship in the great company of the natural sciences, and by placing the mass weight of a substance among its paramount conceptions it has followed the path indicated by Galileo and Newton. Moreover, chemistry and its methods alone have promoted in science a desire to apprehend bodies and their phenomena in their ultimate relations, through a conception of the reaction of their infinitely small parts or atoms which may in fact be regarded as indivisible individuals, having nothing in common with the mechanically indivisible atoms of the ancient metaphysicians. The

building up of molecules from atoms, and of substances from molecules, is then conceived to resemble the building up of systems, such as the solar system, or that of twin stars or constellations, from these individual bodies. This is not a simple play of words in modern chemistry, nor a mere analogy, but a reality which directs the course of all chemical research, analysis, and synthesis. Chemistry has its own microscope for investigating invisible regions, and being an archi-real science it deals all the time with its invisible individualities without considering them mechanically indivisible. The atoms and molecules which are dealt with in all provinces of modern mechanics and physics cannot be other than the atoms and molecules defined by chemistry, for this is required by the unity of science. And therefore the metaphysicians of the present day should, for the advancement of knowledge, regard atoms in the same sense as that in which they are understood by natural science and not after the manner of the ancient metaphysicians of the Chinese or Greek schools. If the Newtonian theory of gravity revealed the existence of forces acting at infinitely great distances, the chemistry of Lavoisier, Dalton and Avogadro Gerhardt, on the other hand, disclosed the existence of forces of immense power acting at infinitely small distances, and transmutable into all other forms of energy, mechanical and physical. Thus all the present-day fundamental conceptions of natural science -- and consequently the conception of the ether -- must necessarily be considered under the combined influence of chemical, physical, and mechanical teachings. Before endeavoring to give an answer respecting the chemical nature of ether, I think it necessary to state my opinion regarding the belief held by some in the unity of the substance of the chemical elements and their origin from one primary form of matter. According to this view, ether consists of this primary matter in an unassociated form, that is, not in the form of the elementary atoms or molecules of substances, but as the constituent principle out of which the chemical atoms are formed. This view has much that is attractive. The atoms are regarded as proceeding from primary matter in the same way as celestial bodies are sometimes represented as being formed from disunited bodies, such as cosmic dust, etc. The celestial bodies so formed remain surrounded by the cosmic dust, etc. So also the atoms remain in the midst of the all-pervading and primary ether from which they took their origin. Some persons assume also that atoms can be split up into their dust or primary matter, just as comets break up into falling stars; and that, as the geological changes of the earth or the building up and dissociation of heavenly bodies proceed before our eyes, so also do the atoms break up and form again in the silence of their eternal evolution. Others, without denying the possibility of such a process in the exceptional rare cases, consider the world of atoms to have been established once for all, and do not admit the possibility of decomposing the atom into its primary matter, or of forming new atoms of any chemical element from this primary matter by experimental means. In a word, they regard the process of the creation of atoms as finite and not subject to repetition, while they consider the ether as the residue remaining after the formation of atoms. This view need not be considered here, it being solely the fruit of imagination and unproved by any experimental investigation. But the former theory of a progressive evolution of the substance of atoms cannot be passed unnoticed by chemistry, for fundamental principles of this science are the indestructibility of matter and the immutability of the atoms forming the elements. If ether were producible fro atoms and atoms could be built up from ether, the formation of new unlooked-for atoms and the disappearance of portions of the elements during experiment would be possible. A belief in such a possibility has long been held in the minds of may by force of superstition; and the more recent researches of Emmens to convert silver into gold, and those of Fittica to prove that phosphorus can be converted into arsenic, show that it yet exists. In the 50 years during which I have carefully followed the records of chemistry, I have met with many such instances, but they have always proved unfounded. It is not my purpose here to defend the independent individuality of the chemical elements, but I am forced to refer to it in speaking of the ether, for it seems to me that, besides being chemically invalid, it is impossible to conceive of an ether as a primary substance, because such a substance should have some mass or weight and also chemical relations -- mass in order to explain the majority of phenomena proceeding at all distances up to the infinitely great, and chemical relations in order to explain those proceeding at distances infinitely small or commensurable with the atoms. If the question were restricted to the ether which fills space and serves as a medium for the transmission of energy, it would in a way be possible to limit oneself to the supposition of mass without reference to its chemical relations and even to consider the ether as a primary matter, Justas the

mass of a planet may be conceived without regarding its chemical composition. But such an indifferent, indefinite ether loses all sense of reality and awakens the misgivings of the earnest investigator, directly he realizes that it must permeate all substances. The necessity I an easy and perfect permeation of all bodies by the ether has to be admitted, not only for the comprehension of many physical phenomena such as those o optics , but also owing to the great elasticity and rarity of the ethereal substance, the atoms of which are always conceived a being far more minute than the atoms and molecules of the known chemical substances. Moreover, this permeability of ether I all bodies explains why it cannot be isolated from substances, which indeed behave in respect to ether like a sieve to water or air. The capacity of the ether to penetrate all substances may, however, be regarded as the ideal of the diffusion of gases through metals and other diaphragms. Hydrogen, which ha a small atomic weight and is the lightest of all known gases, not only diffuses more rapidly than any other gas, but also has the faculty of penetrating through walls of such metals as platinum and palladium, which are impervious to other gases. This property is due, not only to the rapidity of motion of the molecules of hydrogen, closely connected with its small density, but also to a chemical faculty of the same kind as exhibited in the formation of metallic hydrides, of solutions, alloys and other indefinite compounds. The mechanism of this penetration may be likened at the surface of the body penetrated to the solution of a gas in a liquid, that is, to the gaseous particles leaping into the interstices between the particles of the liquid with a retardation of their motion a partial liquefaction of the gas and a bringing into harmony of the motion of both kinds of particles. The condensed gas absorbed at the surface of contact travels in all directions through the body, and diffuses from one layer to another until it entirely permeates it. The possibility of gaseous hydrogen acting thus is evident from the fact that even gold diffuses through solid lead under the same force. At length, at the opposite surface of the body penetrated, the condensed gas will find it possible to escape into greater freedom, and will continue to pass in this direction until its degree of concentration becomes the same on both sides. When this takes place it does not set up a sate of rest, but one of mobile equilibrium, that is, equal numbers of molecules or atoms will escape and leap in at both sides. If, as it must, ether has the faculty of permeating all substances, it must be even lighter and more elastic greater vis viva than hydrogen, and, what is most important, must have less capacity than hydrogen to form chemical compounds with the bodies it permeates. Compounds are characterized by the fact that the diverse atoms in them form systems or molecules, in which the different elements are in compatible, harmonious motion. We must therefore suppose that such a state of harmonious motion of, for instance, hydrogen and palladium, is actually set up in those atoms of hydrogen which permeate the palladium, and that in so doing it forms with the palladium some compound either Pd2H or another which easily dissociates when heated. Hence it seems to me that the atoms of ether are so void of this faculty of forming compounds which is already weak in hydrogen that such compounds dissociate at all temperatures, and that therefore nothing beyond a certain condensation among the atoms of substances can be looked for in the ether. Eight years ago, it would have been most arbitrary to deny the existence, in the substance or atoms of ether, of the faculty of forming any compounds with their chemical elements, for in those days all the known elements were, directly or indirectly, capable of entering into mutual combination. But in Lord Rayleigh and Professor Ramsay discovered argon, and defined it as the most inactive element; this was followed by the discovery of helium, the existence of which Lockyer had predicted by its spectrum as a solar element, and subsequently by the separation of neon, krypton and xenon from air. None of these five new gases have yet given any definite compounds, although they clearly evince the faculty of solution, i. Thus we have now every right to say that the ether is unable to form any stable compounds with other chemical atoms, although it permeates all substances. Hence the ether may be said to be a gas, like helium or argon, incapable of chemical combination. This definition of the ether as a gas, signifies that it belongs to the category of the ordinary physical states of matter, gaseous, liquid or solid. It does not require the recognition of a peculiar fourth state beyond the human understanding Crookes. All mystical, spiritual ideas about ether disappear. Furthermore, if ether be a gas, it has weight; this is undisputable, unless the whole essence of natural science, from the days of Galileo, Newton, and Lavoisier, be discarded for its sake. But since ether possesses so great a penetrative power that it passes through every envelope, it is, of course, impossible to experimentally determine its mass in a given amount o other

substances, or the weight of a given volume of ether. We ought, therefore, not to speak of the imponderability of ether, but only of the impossibility of weighing it. The preceding remarks are in exact accordance with the generally accepted conception of ether. The only addition made is to ascribe to ether the properties of a gas, like argon and helium utterly incapable of entering into true chemical combination. This point lies at the basis of our investigation into the chemical nature of ether, and includes the following two fundamental propositions: The argon group of gases and the periodic system o the elements have such a close bearing upon our further consideration of the chemical nature of ether that it behooves us to look at them more closely. When in I first showed the periodic dependence of the properties of the elements upon their atomic weights, no element incapable of forming definite compounds was known, nor was the existence of such an element even suspected. Therefore the periodic system was arranged by me in groups, series, and periods, starting with group I and series I, with hydrogen as the lightest and least dense of all the elements. It never occurred to me that hydrogen might be the starting point of a system of elements. Guided by this system, I was able to predict both the existence of several unknown elements and also their physical and chemical properties in a free and combined state. These elements, gallium, scandium, and germanium, were subsequently discovered by Lecoq de Boisbaudran, Nilson, and Winkler respectively. I made these predictions by following what is known in mathematics as a method of interpolation, that is, by finding intermediate points by means of two extreme points whose relative position is known. The fact of my predictions having proved true confirmed the periodic system of elements, which may now be considered as an absolute law. So long as the law remained unconfirmed, it was not possible to extrapolate i. My reason for doing this was determined by two considerations. In the first place, I think I have not many years for delay; and, in the second place, in recent years there has been much talk about the division of atoms into more minute electrons, and it seems to me that such ideas are not so much metaphysical as metachemical, proceeding form the absence of any definite notions upon the chemism of ether, and it is my desire to replace such vague ideas by a more real notion of the chemical nature of the ether. For until some one demonstrates either the actual transformation of ordinary matter into ether, or the reverse, or else the transformation of one element into another, I consider that any conception of the division of atoms is contrary to the scientific teaching of the present day; and that those phenomena in which a division of atoms is recognized would be better understood as a separation or emission of the generally recognized and all-permeating ether. In a word, it seems to me that the time has arrived to speak of the chemical nature of the ether, all the more so since, so far as I know, no one has spoken at all definitely on this subject. When I applied the periodic law to the analogs of boron, aluminum, and silicon, I was 33 years younger than now, and I was perfectly confident that sooner or later my prediction would be fulfilled. Now I see less clearly and my confidence is not so great. Then I risked nothing, now I do. This required some courage, which I acquired when I saw the phenomena of radioactivity. I the saw that I must not delay, that perhaps my imperfect thoughts might lead some one to a surer path than that which was opened to my enfeebled vision. First, I will treat of the position of helium, argon, and their analogs in the periodic system; then of the position of ether I this system; and conclude with some remarks on the probable properties of ether according to the position it occupies in the periodic system. When, in , I first heard of argon and its great chemical inertness, I doubted the elementary nature of the gas, and thought it might be a polymeride of nitrogen, N3, just as ozone, O3, is a polymeride of oxygen, with the difference that, while ozone is formed from oxygen with the absorption of heat, argon might be regarded as nitrogen deprived of heat. In chemistry nitrogen was always regarded as the type of chemical inertness, i. Berthelot subsequently published a similar view on the nature of argon, but I have now long discarded that and consider argon to be an independent element, as Ramsay held it to be from the very beginning. An instance of this is seen in the boiling points at mm or temperatures at which the vapor pressures equal the atmospheric pressure and at which the liquid and gaseous phases are co-existent: When the elementary nature of the argon analogs and their characteristic chemical inactivity were once proved, it became essential that they should take their place in the periodic system of the elements; not in any of the known groups but in a special one of their own, for they exhibited new, hitherto unknown chemical properties, and the periodic system embraces in different groups those elements which are analogous in their fundamental chemical properties, although not in dependence upon

these properties but upon their atomic weight, which apparently -- previous to the discovery of the periodic law -- stands in no direct relation to these properties.

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