He called attention to the possibility of choosing in this way between the kinetic theory of gases, which supposes a temperature of 273° C. below zero, and Fourier's theory which assumes that the temperature of space above the atmosphere is near that of the minima observed in the polar regions of the earth.

Future international balloon ascensions were next considered. It was deemed advisable that—

> For each *ballon sonde* an instrument should be provided to serve as a basis of comparison with perfected instruments whose construction may change from one ascent to another on account of the improvements which may be attempted.

It was announced that in the next international ascent of *ballons sondes* Austria, Italy and Belgium would participate, besides the countries which had already co-operated. This ascent was appointed for the beginning of June with certain stations of the international system to be chosen as starting points. The balloons should be as nearly as possible like those approved by the Conference, and the directors of the various meteorological systems were requested to institute observations on the days of the ascents according to the principles fixed by the President of the Committee. It was recommended that—

> For the simultaneous study of the lower air strata, the observations from high stations be used, and especially those from kites and kite balloons.

After a presentation of various methods for effecting the safe landing and the recovery of *ballons sondes*, resolutions looking to these ends were adopted. Balloons may be protected against explosion caused by atmospheric electricity by covering their interior surface with a solution of potassium chlorate, which renders the fabric a conductor. For the measurement of atmospheric electricity the methods of Le Cadet, Börnstein and André are recommended, especially the former.

Mr. Rotch read the report which he had been requested to prepare on the use of kites at Blue Hill Observatory, U.S.A., to obtain meteorological observations. He showed the advantages which kites possess over balloons up to heights exceeding 10,000 feet, whenever there is wind.

A letter from the Chief of the Weather Bureau explained the proposed use of kites to obtain data for a daily synoptic weather chart over the United States at the height of a mile or more. M. Teisserenc de Bort is equipping a kite station at Trappes, near Paris, after the model of Blue Hill, and General Rykatcheff stated that an anemograph of his invention was being raised with Hargrave kites at St. Petersburg. The Conference recommended the use of the kite in meteorology, and expressed the wish that all central observatories should make such observations, which are of prime importance for meteorology. On account of the favourable position of Mounts Cimone and Etna it is desirable that at the observatories on these mountains kites should be used in connection with the international balloon ascensions. The Conference expressed the desire that the chief observatories should be provided with the kite balloon of von Parseval and von Siegsfeld (see description hereafter) in order that there may be a certain number of permanent aerial stations, and following the idea of M. Tacchini it is hoped that kite balloons will be used in Italy on Mounts Viso and Etna, and also at the Military Park at Rome.

The following new members of the Committee were elected: M. Teisserenc de Bort and Prince Roland Bonaparte, of Paris, Prof. Hildebrandsson, of Upsala, Prof. Pernter and Lieut. Hinterstoisser, of Vienna, Captain Moedebeck, of Strassburg, and Lieut. von Siegsfeld, of Berlin. The next meeting was appointed for 1900, at Paris, during the Universal Exposition.

The Committee had the opportunity of witnessing two trials of the captive kite balloon, invented by Lieuts. von Parseval and von Siegsfeld, and constructed by Riedinger, of Augsburg, at a cost of 1000 dols., for Prof. Hergesell and Captain Moedebeck. Although this form of balloon is used in the German army for reconnoitring, it was now employed for the first time to lift self-recording meteorological instruments. The cylindrical balloon is so attached to the cable that its upper end inclines towards the wind, which thus raises instead of depressing it, as in the case of captive spherical balloons. The wind enters an auxiliary envelope at the lower extremity and maintains the cylindrical form, notwithstanding any loss of gas. This wind bag also serves as a rudder, while lateral wings prevent rotation about the longer axis. The Strassburg balloon has a diameter of 14·7 feet, a length of 55·7 feet, and a volume of 7770 cubic feet. The gas bag is varnished linen, and was filled with a mixture of hydrogen and coal gas. The weight of the balloon complete is 230 pounds, and the steel cable holding it weighs 2 pounds per 100 feet. The azimuth, altitude, and traction of the cable are recorded by a dynamometer invented by Riedinger. The meteorological instruments are contained in a basket (with open ends, through which the wind blows, but covered elsewhere with nickeled paper as a protection against insolation), suspended some 40 feet below the balloon. The self-recording instruments were a barometer and thermometer of Richard and a Robinson anemometer recording electrically. Although the kind of gas employed was hardly sufficient to lift the unnecessarily heavy basket and its contents, weighing 80 pounds, yet the trials made in rainy and windy weather were fairly successful, and a height of about 1000 feet was reached. Without instruments the balloon had remained for several days above the city, and had withstood a gale.

The Committee also saw a hastily organised ascent of the *ballon sonde*, "Langenburg," which is a silk balloon of about 14,000 cubic feet capacity. When filled with coal gas it had an initial ascensional force of about 440 pounds in excess of its own weight and that of the instruments, contained in a cylindrical basket, which was open at top and bottom for ventilation, and was also covered with nickeled paper. They comprised a barometer and thermometer of Richard, and the metallic thermometer of Teisserenc de Bort, which all recorded on smoked paper. Owing to the premature launch of the balloon the ballast was left behind, and the escape of gas, owing to the too rapid ascent, prevented a great height from being reached. The balloon rose at about 6 p.m. with a velocity of nearly 23 feet per second, and disappeared in the strato-cumulus clouds in five minutes. It attained an altitude exceeding 6 miles, and fell about 60 miles south-east of Strassburg, where it was found the next day. Unfortunately the shock caused by the breaking loose of the balloon stopped the clocks of the thermographs and prevented records of temperature from being obtained.

An official account of this Conference will be published in the French and German languages, together with the special reports prepared by the experts.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

AMONG the measures which received the Royal consent on Friday was the London University Commission Bill.

MR. A. J. HERBERTSON, Lecturer on Geography in the Heriot-Watt College, Edinburgh, has taken the degree of Ph.D., *multa cum laude*, in the University of Freiburg, Baden, in the special subject of geography. The subject of his thesis was the mean monthly rainfall of the globe, illustrated by twelve original maps.

THE resident professorship of Physics and Mechanics in the Royal Agricultural College, Cirencester, has been filled up by the election of Mr. John Alexander Johnston. At Edinburgh Mr. Johnston was first medallist in advanced honours class of mathematics, and first medallist in advanced honours class of physics, and in 1894 he graduated M.A. with first class honours in mathematics and physical science, and afterwards obtained the Drummond scholarship for proficiency in physical science, as well as other open honours. At Pembroke College, Cambridge, he was awarded both minor and foundation scholarships, and graduated fourteenth wrangler in the mathematical tripos.

A SPECIAL and valuable feature of the Museum of the Peabody Institute at Salem, Mass., is referred to by Mr. W. E. Hoyle in the course of a description of museums in the United States and Canada, contained in the report of the Manchester Museum, Owens College (1897–8). Mr. Hoyle mentions that at close intervals throughout the entire collection special coloured labels are displayed, calling attention, by title and shelf number, to books in the public library referring to the immediate group, so that a student or pupil from the public schools need only transcribe on a bit of paper a set of numbers and present it at the delivery window of the public library to be provided at once with the books on the special subject desired.

THE following list of candidates successful in this year's competition for the Whitworth Scholarships and Exhibitions, has been issued by the Department of Science and Art:—Scholarships of 125*l.* a year, tenable for three years—Charles E. Goodyear, Devonport; John H. Grindley, Oldham; Harry E. Wimperis, Bath; George Service, Cambuslang. Exhibitions of 50*l.* a year, tenable for one year—William V. Shearer, Glasgow; William Alexander, Glasgow; Albert Hall, London; Aidan N. Henderson, Edinburgh; Alec W. Quennell, London; Victor G. Alexander, Portsmouth; George S. Taylor, Devonport; Joel J. Lee, Portsmouth; George Donington, Lincoln; John E. Jagger, Manchester; George A. Inglis, Glasgow; Leslie H. Hounsfield, London; William M. Selvey, Devonport; Ernest A. Forward, London; James J. Mills, Plumstead; Robert M. Neilson, Glasgow; William A. Barnes, Horwich (Lancs.); Francis P. Johns, Torpoint; Herbert H. Johnson, Liverpool; William T. Williams, London; Frederick Charlesworth, Crewe; William A. Craven, Birkenhead; George A. Barber, Manchester; Hugh M. Macmillan, Govan; James C. Macfarlane, Cathcart; George G. Sumner, Manchester; Charles L. Vaughan, Plumstead; William E. M. Curnock, Liverpool; Francis D. Moulang, Inchicore (Dublin); John Webster, Gateshead.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 9.—"On the Position of Helium, Argon, and Krypton in the Scheme of Elements." By Sir William Crookes, F.R.S.

It has been found difficult to give the elements argon and helium (and I think the same difficulty will exist in respect to the gas krypton) their proper place in the scheme of arrangement of the elements which we owe to the ingenuity and scientific acumen of Newlands, Mendeléef and others. Some years ago, carrying a little further Prof. Emerson Reynolds's idea of representing the scheme of elements by a zigzag line, I thought of projecting a scheme in three dimensional space, and exhibited at one of the meetings of the Chemical Society[1] a model illustrating my views. Since that time, I have rearranged the positions then assigned to some of the less known elements in accordance with later atomic weight determinations, and thereby made the curve more symmetrical.

Many of the elemental facts can be well explained by supposing the space projection of the scheme of elements to be a spiral. This curve is, however, inadmissible, inasmuch as the curve has to pass through a point neutral as to electricity and chemical energy twice in each cycle. We must therefore adopt some other figure. A figure-of-eight will foreshorten into a zigzag as well as a spiral, and it fulfils every condition of the problem. Such a figure will result from three very simple simultaneous motions. First, an oscillation to and fro (suppose east and west); secondly, an oscillation at right angles to the former (suppose north and south); and thirdly, a motion at right angles to these two (suppose downwards), which, in its simplest form, would be with unvarying velocity.

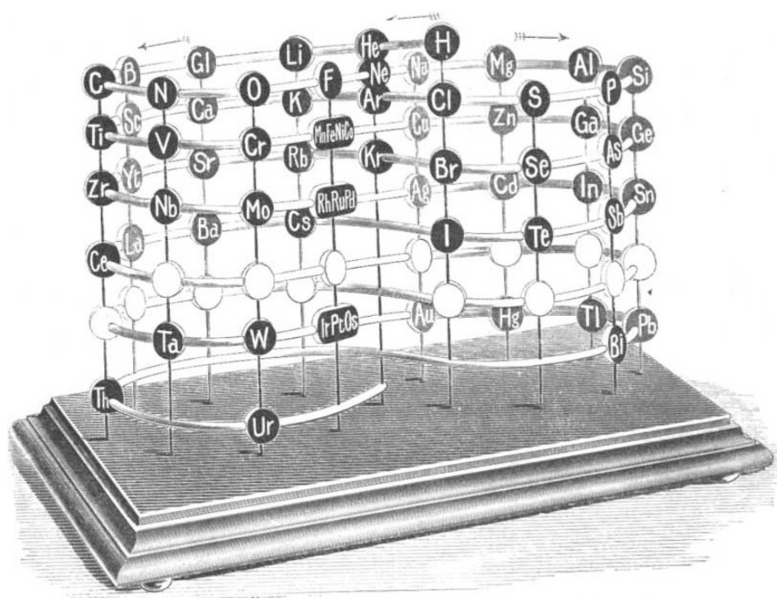
I take any arbitrary and convenient figure-of-eight, without reference to its exact nature; I divide each of the loops into eight equal parts, and then drop from these points ordinates corresponding to the atomic weights of the first cycle of elements. I have here a model representing this figure projected in space; in it the elements are supposed to follow one another at equal distances along the figure-of-eight spiral, a gap of one division being left at the point of crossing. The vertical height is divided into 240 equal parts on which the atomic weights are plotted, from H = 1 to Ur = 239·59. Each black disc represents an element, and is accurately on a level with its atomic weight on the vertical scale.

The accompanying figure, photographed from the solid model, illustrates the proposed arrangement. The elements falling one under the other along each of the vertical ordinates, are

H	He	Li	Gl	B	C	N	O	F	Na	Mg	Al	Si	P	S
Cl	Ar	K	Ca	Sc	Ti	V	Cr	Mn·Fe·Ni·Co	Cu	Zn	Ga	Ge	As	Se
Br	Kr	Rb	Sr	Yt	Zr	Nb	Mo	Rh·Ru·Pd	Ag	Cd	In	Sn	Sb	Te
I	—	Cs	Ba	La	Ce	( )	( )	( )	( )	( )	( )	( )	( )	( )
( )	—	( )	( )	( )	( )	Ta	W	Ir·Pt·Os	Au	Hg	Tl	Pb	Bi	—
—	—	—	—	—	Th	—	Ur	—	—	—	—	—	—	—

The bracketed spaces between cerium and tantalum are probably occupied by elements of the didymium and erbium groups. Their chemical properties are not known with sufficient accuracy to enable their positions to be well defined. They all give coloured absorption spectra, and have atomic weights between these limits. Positions marked by a dash (—) are waiting for future discoverers to fill up.

Let me suppose that at the birth of the elements, as we now know them, the action of the *vis generatrix* might be diagrammatically represented by a journey to and fro in cycles along a figure-of-eight path, while, simultaneously, time is flying on, and some circumstance by which the element-forming cause is conditioned (*e.g.* temperature) is declining; (variations which I have endeavoured to represent by the downward slope). The result of the first cycle may be represented in the diagram by supposing that the unknown formative cause has scattered along its journey the groupings now called hydrogen, lithium, glucinum, boron, carbon, nitrogen, oxygen, fluorine, sodium, magnesium, aluminium, silicon, phosphorus, sulphur, and chlorine. But the swing of the pendulum is not arrested at the end of the first round. It still proceeds on its journey, and had the conditions remained constant, the next elementary grouping generated would again be lithium, and the original cycle would eternally reappear, producing again and again the same fourteen elements. But the conditions are not quite the same. Those represented by the two mutually rectangular horizontal components of the motion (say chemical and electrical energy) are not materially modified; that to which the vertical component corresponds has lessened, and so, instead of lithium being repeated by lithium, the grouping which forms the commencement of the second cycle is not lithium, but its lineal descendant, potassium.



It is seen that each coil of the lemniscate track crosses the neutral line at lower and lower points. This line is neutral as to electricity, and neutral as to chemical action. Electro-positive elements are generated on the northerly or retreating half of the swing, and electro-negative elements on the southerly or approaching half. Chemical atomicity is governed by distance from the central point of neutrality; monatomic elements being one remove from it, diatomic elements two removes, and so on. Paramagnetic elements congregate to the left of the neutral line, and diamagnetic elements to the right. With few exceptions, all the most metallic elements lie on the north.

Till recently chemists knew no element which had not more or less marked chemical properties, but now by the researches of Lord Rayleigh and Prof. Ramsay, we are brought face to face with a group of bodies with apparently no chemical properties

[1] Presidential address to the Chemical Society, March 28, 1888.