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.

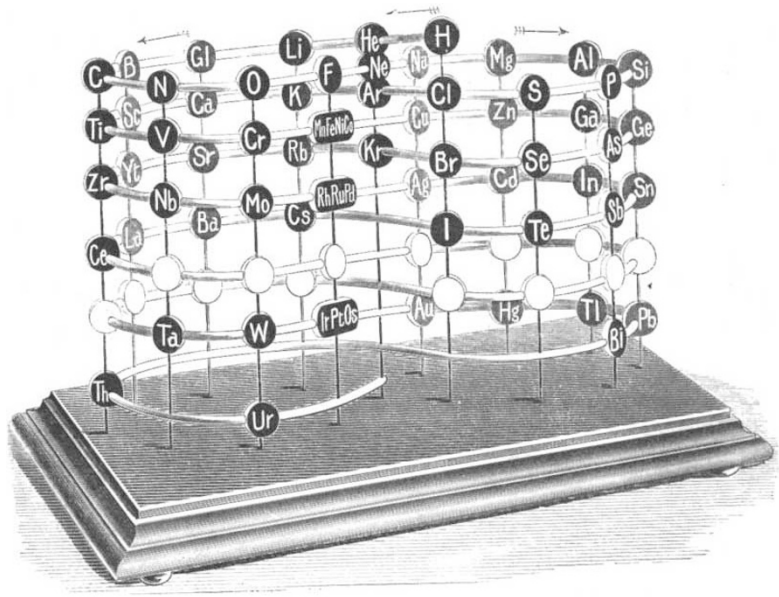
I take any arbitrary and convenient figure-of-eight, without reference to its exact nature; I divide each of the loops into eight equal parts, and then drop from these points ordinates corresponding to the atomic weights of the first cycle of elements. I have here a model representing this figure projected 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. Electropositive 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.

forming an exception to the other chemical elements. I venture to suggest that these elements, helium, argon, and krypton in this scheme naturally fall into their places as they stand on the neutral line. Helium, with an atomic weight of 4, fits into the neutral position between hydrogen and lithium. Argon, with an atomic weight of about 40, as naturally falls into the neutral position between chlorine and potassium. While krypton, with an atomic weight of about 80, will find a place between bromine and rubidium.

See how well the analogous elements follow one another in order: C, Ti, and Zr; N and V; Gl, Ca, Sr, and Ba; Li, K, Rb, and Cs; Cl, Br, and I; S, Se, and Te; Mg, Zn, Cd, and Hg; P, As, Sb, and Bi; Al, Ga, In, and Tl. The symmetry of these series shows that we are on the right track. It also shows how many missing elements are waiting for discovery, and it would not now be impossible to emulate the brilliant feat of Mendeléef in the celebrated cases of Eka-silicon and Eka-aluminium. Along the neutral line alone are places for many more bodies, which will probably increase in density and atomic weight until we come to inert bodies in the solid form.

Three groups are seen under one another, each consisting of closely allied elements which Prof. Mendeléef has relegated to his eighth family. They congregate round the atomic weight 57, manganese, iron, nickel and cobalt; round the atomic weight 103, ruthenium, rhodium and palladium; while lower down round atomic weight 195 are congregated osmium, iridium and platinum. These groups are interperiodic because their atomic weights exclude them from the small periods into which the other elements fall; and because their chemical relations with some members of the neighbouring groups show that they are interperiodic in the sense of being formed in transition stages.

[*Note, June* 22.—Since the above was written, Prof. Ramsay and Mr. Travers have discovered two other inert gases accompanying argon in the atmosphere. These are called Neon and Metargon. From data supplied me by Prof. Ramsay, it is probable that neon has an atomic weight of about 22, which would bring it into the neutral position between fluorine and sodium. Metargon is said to have an atomic weight of about 40; if so, it shares the third neutral position with argon. I have marked the positions of these new elements on the diagram.]

PARIS.

Academy of Sciences, August 8, 1898.—M. Wolf in the chair.—On the theory of the zenithal telescope, by M. Hatt. An exposition in reply to some objections raised by M. Verschaffel.—Some points in the normal and pathological physiology of the heart, revealed by radioscopic examination, by M. Ch. Bouchard. This paper treats of the movements of the heart during respiration, both in the normal state and in the presence of diseases of the respiratory organs.—The double embryo of *Diplosomides* and tachygenesis, by MM. Edmond Perrier and Antoine Pizon.—The number and symmetry of the libero-ligneous bundles of the petiole as a measure of the gradation of vegetable species, by M. Ad. Chatin. The monocotyledons are dealt with in this article.—Experiments on the production of Alpine characters in plants by the alternation of extreme temperatures, by M. Gaston Bonnier. Comparative experiments were made with a number of plants cultivated under three different sets of conditions, the first being maintained at a constant low temperature (4° to 9° C.), the second subjected to the normal variations in temperature in the neighbourhood of Paris, and the third maintained at a very low temperature during the night and exposed to the sun in the day. Under the last-named conditions the plants exhibited the stunted growth, the short internodes, the small thick leaves, and the speedy efflorescence characteristic of Alpine species.—On the preparation of cultures of Koch's bacillus, most favourable for the study of the phenomena of agglutination in the blood-serum of tuberculous subjects, by MM. S. Arloing and Paul Courmont.—On the infinitely small deformation of an elastic ellipsoid, by MM. E. and F. Cosserat.—On simple kathode rays, by M. E. Goldstein.—On the superposition of two stereoscopic couples, by MM. T. Marie and H. Ribaut.—On monopyrocatechin glyoxal, by M. Ch. Moureu. The compound of the formula $C_8H_8O_4$, recently described by M. Julius Hesse, and obtained by him from a derivative of monopyrocatechin glyoxal, is shown to be identical with the orthohydroxyphenoxy-acetic acid produced by hydrolysis of ethane-dipyrocatechin (dipyrocatechin glyoxal). This result confirms the author in his supposition that monopyrocatechin glyoxal is an intermediate product in the hydrolysis of dipyrocatechin glyoxal.—Action of oxygen upon yeast, by M. Jean Effront. On exposure of yeast to air, absorption of oxygen takes place, accompanied by a considerable rise of temperature. This is due to the presence of an oxidising enzyme which will be subsequently described.—Study of the phosphoric acid dissolved by the water of the soil, by M. Th. Schlœsing fils. As has been already pointed out, the percentage of phosphoric acid held in solution by the water of the soil depends only on the nature of the latter, and is independent of the absolute amount of water present. On this fact is based a simple and expeditious method of determining the dissolved phosphoric acid in soils. The sample is agitated for ten hours with a large volume of water and the phosphoric acid estimated in an aliquot part of the clarified liquid. The result thus obtained, combined with a determination of the moisture in the soil, gives the information required.—On the mechanism of immunisation against the globulicidal action of snake serum, by MM. L. Camus and E. Gley.—Transmission of toxines from the fœtus to the mother, by M. A. Charrin. Experiments were made upon rabbits.—Influence of carbonic acid on the form and structure of plants, by M. Em. C. Téodoresco. Plants were grown in air deprived of carbonic acid, and in air to which a definite amount of the gas had been added. Certain morphological differences were observed.—"Jaundice," a bacteriological disease of the beetroot, by MM. Prillieux and Delacroix. The bacterial nature of the disease has been demonstrated, and confirmed by inoculation experiments.—Apparatus for taking radiographs of the thoracic cage during inspiration and expiration: results obtained, by M. Guilleminot. The construction of the apparatus was suggested by the experiments of M. Bouchard, whose observations are confirmed.—A luminous meteor, observed at Bourg-d'Ault (Somme), by M. C. Rozé.

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