Vicky Wong

Dimitri Mendeleev

and the periodic pattern

Dimitri Mendeleev

In 1863 there were 56 known elements and new elements were being discovered at the rate of about one per year. There were several attempts to bring some sort of order to the elements, but Mendeleev was one of the few who realised that not all the elements had been discovered and so left spaces for them in his table. He put the elements in order by atomic weight and by the patterns in their properties. He assumed that they must go in order of mass, but if they seemed to fit better elsewhere by their properties he moved them, and presumed that others had made mistakes in their calculation of atomic mass.

The modern periodic table is not arranged by atomic mass but by atomic number and many of the atomic masses that Mendeleev assumed were wrong were in fact correct. Atomic number is the number of protons in the atom but when Mendeleev put his table together not all chemists even agreed that atoms existed and they had not discovered protons or the atomic number. Usually putting the elements in sequence by mass gives the same order as by atomic number, but there are a few examples where this is not the case. But ignoring the mass where it did not quite fit the pattern allowed Mendeleev to build up his periodic table into something that was useful to chemists rather than just an interesting list.

Reihen	Gruppo I. — R^2O	Gruppo II. — RO	Gruppo III. — R^2O^3	Gruppo IV. RH^4 RO^2	Gruppo V. RH^3 R^2O^5	Gruppo VI. RH^2 RO^3	Gruppo VII. RH R^2O^7	Gruppo VIII. — RO^4
1	H=1							
2	Li=7	Be=9,4	B=11	C=12	N=14	O=16	F=19	
3	Na=23	Mg=24	Al=27,3	Si=28	P=31	S=32	Cl=35,5	
4	K=39	Ca=40	—=44	Ti=48	V=51	Cr=52	Mn=55	Fe=56, Co=59, Ni=59, Cu=63.
5	(Cu=63)	Zn=65	—=68	—=72	As=75	Se=78	Br=80	
6	Rb=85	Sr=87	?Yt=88	Zr=90	Nb=94	Mo=96	—=100	Ru=104, Rh=104, Pd=106, Ag=108.
7	(Ag=108)	Cd=112	In=113	Sn=118	Sb=122	Te=125	J=127	
8	Cs=133	Ba=137	?Di=138	?Ce=140	—	—	—	— — — —
9	(—)	—	—	—	—	—	—	
10	—	—	?Er=178	?La=180	Ta=182	W=184	—	Os=195, Ir=197, Pt=198, Au=199.
11	(Au=199)	Hg=200	Tl=204	Pb=207	Bi=208	—	—	
12	—	—	—	Th=231	—	U=240	—	— — — —

Mendeleev's periodic table of 1871; note the spaces under aluminium (Al) and silicon (Si) with Mendeleev's predicted atomic masses of 68 and 72.

Patterns that predict

Mendeleev's real genius was in realising the predictive power of the periodic table. He used the patterns in the properties of known elements to predict the properties of several undiscovered elements. Within 15 years of him making these predictions public, three of the elements had been identified and their properties shown to match those he had predicted.

The first of these Mendeleev had called eka-Aluminium as it was the one after Aluminium. It was identified in 1875 by the Frenchman Paul de Boisbaudran who called it Gallium. Mendeleev was justifiably pleased when its properties were shown to be very similar to those he had predicted. However, de Boisbaudran gave the value for the density as 4.9 g/cm^3 and this was quite different to the 6.0 g/cm^3 Mendeleev was expecting. He got the Frenchman to check and de Boisbaudran found that the value should have been 5.9 g/cm^3 which was far closer to Mendeleev's prediction.

Creating elements

After Mendeleev's death, scientists began not just discovering but creating elements by fusing atoms together. A whole new section of the periodic table was opening up for these really heavy elements which had not been present in Mendeleev's lifetime. Most only exist for fractions of a second before radioactive decay sees them transform into something else.

Glenn Seaborg pointing to the element named after him on the periodic table. He is the only person to have an element named after them while still alive.

Element number 106 is Seaborgium (Sg) which was first made in the 1970s. The short lifetime of the atoms made finding out about the chemistry very difficult, but the properties were predicted using the periodic table. Sg was expected to be similar to the elements above it (molybdenum (Mo) and tungsten (W)) and to:

- have a valency of 6
- react with oxygen and chlorine to form an oxychloride with the formulae SgO_2Cl_2
- form negatively charged complex ions.

In the late 1990s researchers were able to produce Seaborgium at the rate of one atom an hour and using fewer than 10 atoms showed that the predictions made using Mendeleev's periodic table were once again correct. Mendeleev would certainly have been pleased, but perhaps not very surprised.

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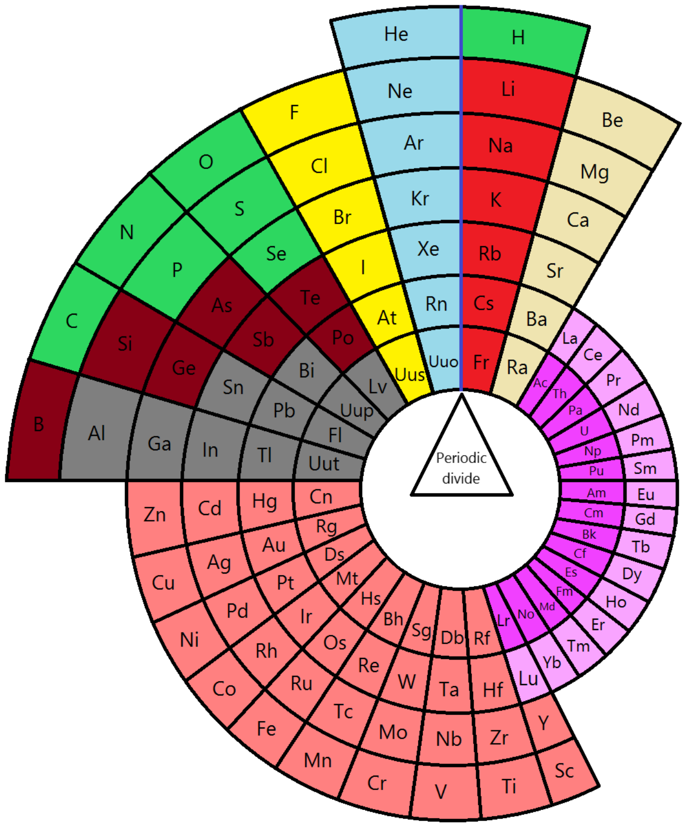

The information in the periodic table does not have to be shown in the traditional block system and other forms have been devised such as this circular periodic table.

Look here!

The previous issue of Catalyst (Vol 26 issue 3) had another article on discovering new elements:

http://tinyurl.com/jydblgs