Early Attempts in Classification of Elements

Dobereiner's Traids:

When Elements arranged in order of their increasing atomic mass , the atomic mass of the middle element was approximately the arithmetic mean of the other two elements of the traid.

Dobereiner's traid Examples:

Triad	At. wt. of middle element
1. Li^{7} Na^{23} K^{39}	$\frac{7+39}{2} = 23.0$
2. Ca^{40} $Sr^{87.5}$ Ba^{137}	$\frac{40+137}{2} = 88.5$
3. $Cl^{35.5}$ Br^{80} I^{127}	$\frac{35.5+127}{2} = 81.25$

Significance of Dobereiner's Triads:

This classification of elements in triads had greater significance in predicting the atomic mass and properties of the middle element. However, only a few elements could be arranged in such triads.

Drawbacks:

Dobereiner's method of classification could arrange only a limited number of elements out of those known at that time in the form of triads. Therefore, the idea of triads could not be applied to all the elements then known.

Newland Law of octaves:

When elements are arranged in the increased order of their atomic weight, the eight element resembles the first in physical and chemical properties just like the eighth note on a musical scale resembles the first note. According to this law, sodium, the eighth element from lithium has similar properties to that of lithium, the first element and similar observation have been made for Be & Mg, B & Al and so on.

1.	Li^{7}	Be^{9}	B^{11}	C^{12}	N^{17}	O^{16}	F^{19}
2.	Na^{23}	Mg^{24}	Al^{27}	Si^{28}	P^{31}	S^{32}	$Cl^{35.5}$
3.	K^{39}	Ca^{40}					

Drawbacks of Law of Octaves:

(i) This law could be best applied, only up to the element calcium.

(ii) Newly discovered elements could not fit into the octave structure.

(iii) It failed to exhibit this feature with heavier elements.

Mendeleev's periodic table

Tabular Arrangement of elements in the increasing order of their atomic masses in different groups and periods.

Mendeleev (1871) arranged all the known 63 elements of that time in the increasing order of their atomic masses. The arrangement of elements in horizontal rows (called periods) and vertical columns (called groups). This arrangement showed that the elements having similar chemical properties came directly under one another in the same group.

Mendeleev's original table consists of eight vertical columns (called groups) I-VIII & six horizontal rows (called periods).

Group	I	II	III	IV	V	VI	VII	VIII
Oxide Hydride	R_2O RH	RO RH_2	R_2O_3 RH_3	RO_2 RH_4	R_2O_5 RH_3	RO_3 RH_2	R_2O_7 RH	RO_4
Periods	A B	A B	A B	A B	A B	A B	A B	
1	H 1.008							
2	Li 6.93	Be 9.01	B 10.81	C 12.01	N 14.00	O 15.99	F 18.99	
3	Na 22.99	Mg 24.31	Al 26.98	Si 28.09	P 30.97	S 32.06	Cl 35.45	
4 1st Series 2nd Series	K 39.10 Cu 63.5	Ca 40.08 Zn 65.4	— 44 — 68	Ti 47.90 — 72	V 50.94 As 74.9	Cr 52.10 Se 79.0	Mn 54.9 Br 79.9	Fe Co Ni 55.85 58.93 58.71
5 1st Series 2nd Series	Rb 85.5 Ag 107.9	Sr 87.6 Cd 112.4	Y 88.9 In 114.82	Zr 91.2 Sn 118.69	Nb 92.91 Sb 121.75	Mo 95.94 Te 127.60	Tc 99.0 I 126.9	Ru Rh Pd 101.0 102.9 106.4
6 1st Series 2nd Series	Cs 132.9 Au 196.97	Ba 137.3 Hg 200.59						

Main features of Mendeleev's periodic table

(i) In Mendeleev's table, the elements were arranged in vertical columns, called groups.

(ii) There were in all eight groups: Group I to VIII. The group numbers were indicated by Roman numerals. i.e., I, II, III, IV, V, VI, VII & VIII.

(iii) Except VIII, every group is further divided into subgroups i.e., A and B. Groups VIII occupy three triads of three elements each, i.e., in all nine elements

(iv) The properties of the elements in same group or subgroup are similar.

(v) There is no resemblance in the elements of subgroups A and B of same group except valency.

(vi) The horizontal rows of the periodic table are known as periods.

(vii) There were seven periods, represented by Arabic numerals 1 to 6. To accommodate more elements, the periods 4, 5, 6 were divided into two halves. The first half of the elements are placed in the upper left corner and second half in the lower right corner.

For example, the elements occupying the box corresponding to group I and period 4 are potassium (K) and copper (Cu), K is written in the top left corner, while Cu is written in the lower right corner.

(viii) A period comprises the entire range of elements after which the properties repeat themselves.

(ix) In a period, the properties of the elements gradually change from metallic to non-metallic while moving from left to right.

(x) There were gaps left in the periodic table. Mendeleev left these gaps knowingly, as these elements were not discovered at that time.

Merits of Mendeleev's Periodic Table

Mendeleev's classification was considered superior to the others proposed earlier because of the following reasons.

i) Systematic study of the elements:

Mendeleev's classification condensed the study of about 90 elements (only 63 – 65 elements were known at that time, but he left a provision for many more) to the study of only 8 groups of elements.

ii) Prediction of new elements and their properties:

He left some gaps in his periodic table for the undiscovered elements and could even predict the properties of undiscovered elements.

e.g., eka – boron = scandium

eka – aluminium = gallium

eka - silicon = germanium

iii) Correction of certain atomic masses:

By placing elements strictly according to the similarity in their properties, he was also able to correct certain atomic masses.

e.g., He corrected the atomic masses of beryllium (Be), gold (Au) and platinum (Pt).

'Be' had been assigned atomic mass is 13.5.

Atomic weight = equivalent mass * valency factor = 4.5 * 3 = 13.5

It should be placed between carbon and nitrogen but its properties resemble with magnesium and calcium with valence of 2 and the corrected mass of Be came out to be 9. i.e., 4.5 * 2 = 9.

Demerits of Mendeleev's Periodic Table

i) Position of hydrogen:

The position of hydrogen is not correctly defined. It is still not certain whether to place hydrogen in group I A or VII A.

(ii) Anomalous pairs of elements:

In certain pairs of elements like, Ar (40) and K (39); Co (58.9) and Ni (58.6); Te (127.6) and I (126.9) the arrangement was not justified. For e.g., argon was placed before potassium whereas its atomic mass is more than potassium. In this case, the periodic law is violated.

(iii) Position of isotopes: Isotopes have not been given separate places in the periodic table.

(iv) Grouping of elements:

Certain chemically dissimilar elements have been grouped together. Elements of group IA such as lithium, sodium and potassium were grouped with dissimilar elements such as copper, silver, and gold.

(v) Position of lanthanides and actinides

Fourteen elements that follow lanthanum called lanthanides and fourteen elements following actinium called actinides were not given proper places in Mendeleev's periodic table.