In conclusion, the writer wishes to extend his thanks to the Editor for his kind and helpful criticisms.

Summary.

A method is suggested whereby it is possible to read small temperature intervals on a common thermometer by measurements of the parallax on an auxiliary scale.

It is possible to eliminate several heretofore troublesome errors in the boiling-point method of determining molecular weights by using but one reference point on the thermometer scale during a given determination, having established this point by the use of a known substance having a high degree of purity.

It follows from the above that the use of a calibrated thermometer is not essential to accurate work.

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[CONTRIBUTION FROM THE CHEMICAL LABORATORY OF THE UNIVERSITY OF CALIFORNIA.]

A NEW TABLE OF THE PERIODIC SYSTEM.

BY INGO W. D. HACKH.

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The progress of chemistry and the increase of our knowledge require a modification of the classical periodic table. The many proposed "new" tables indicate the interest and demand for a suitable table. Recent papers employ mainly spirals or curves in order to show the different length of the periods. But these graphical representations are cumbersome for practical use on account of their difficult reproduction. In the following a table will be described, which has been derived from a spiral, and thus embodies the advantages of the different models of the periodic system.

The principle involved in a tabular representation of the periodic system is illustrated by Fig. 1, which shows the structure of the system, that is the different length of the periods and the characteristic of the elements in the sub-periods. The terminals of a period are the noble gases, with zero valency and infinite electro-potential. Between each terminal the elements change from positive to negative and the transition point is an element of the carbon family. In the third and fourth period a sub-period (III′, IV′) appears with a change in the inverse direction as seen from Fig. 1. The corresponding sub-periods with analogous elements are clearly expressed in the periodicity of the valency and electromotive force as shown in Fig. 1.

This principle of sub-periods is expressed in the proposed table of the periodic system as reproduced in Table I. The framework of the table

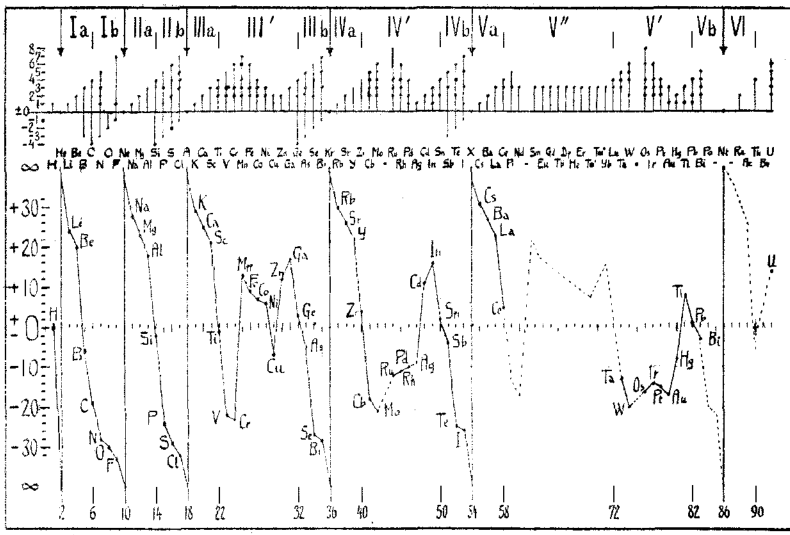


Fig. 1.—The structure of the periodic system illustrated by valency and electromotive force of the elements.

Structure: indicated by *sub-periods.*

Noble gases are the *terminals* of periods.

Elements of carbon family are the *transition points* of the sub-periods.

Sub-periods are indicated at the top of figure.

Terminals and transition points are shown by the atomic numbers of the elements at the bottom of figure.

Valency: expressed by polar numbers of the different types of compounds of an element.

In *a*-sub-periods = invariant valences.

In *b*-sub-periods = polar number differs by two.

In ′-sub-periods = polar number differs by one.

Isometric compounds have same polar number, *e. g.*, the "vitriols" in III′ have polar number 2, the "alumns" in III′ have polar number 3, etc.

Electro-potential: expressed by the relative electromotive force. The curve is obtained by plotting the elements in the order of the "displacement series."

a-sub-period = elements are strong positive.

b-sub-group = elements are strong negative.

′ sub-group = change from negative to positive.

is composed of the elements which form the transition points of the sub-periods, that is, the members of the carbon family, and these elements serve as "guides," being placed in the first and last columns.

The many gaps appearing in the familiar table are eliminated, and the elements thus come closer together. There are many evidences that only 5 elements (at the 5 gaps indicated) remain to be discovered. This is not such a large number as indicated by the old table. The groups of elements are preserved and a clearcut classification of the elements into non-metals (upper left side), noble gases (upper center), light metals (upper right side), heavy metals (lower part), is substantiated, which, however, is flexible enough to meet more detailed requirements, *e. g.*, iron family in sub-period III′, the rare earth family in V″, etc., etc.

TABLE I.—THE PERIODIC SYSTEM OF THE ELEMENTS.
(Atomic numbers, symbols, groups, periods.)

	4	5A	6A	7A	0	1A	2A	3A	4	
Vb	82 Pb	83 Bi	84 Po	85	86 Nt	87	88 Ra	89 Ac	90 Th	VI
IVb	50 Sn	51 Sb	52 Te	53 I	54 Xe	55 Cs	56 Ba	57 La	58 Ce	Va
IIIb	32 Ge	33 As	34 Se	35 Br	36 Kr	37 Rb	38 Sr	39 Y	40 Zr	IVa
IIb	14 Si	15 P	16 S	17 Cl	18 Ar	19 K	20 Ca	21 Sc	22 Ti	IIIa
Ib	6 C	7 N	8 O	9 F	10 Ne	11 Na	12 Mg	13 Al	14 Si	IIa
				1 H	2 He	3 Li	4 Be	5 B	6 C	Ia
III′	22 Ti	23 V	24 Cr	25 Mn	26 27 28 Fe Co Ni	29 Cu	30 Zn	31 Ga	32 Ge	III′
IV′	40 Zr	41 Cb	42 Mo	43	44 45 46 Ru Rh Pd	47 Ag	48 Cd	49 In	50 Sn	IV′
V″	58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 Ce Pr Nd Sa Eu Gd Tb Dy Ho Er Ad Cp Yb Lu									V″
V′	72 Lu	73 Ta	74 W	75	76 77 78 Os Ir Pt	79 Au	80 Hg	81 Tl	82 Pb	V′
VI	90 Th	91 Bv	92 U							
	4	5B	6B	7B	8	1B	2B	3B	4	

In the *upper* half of the table are the elements possessing high electro-potential, simple spectra, colorless ions. The properties are analogous in the vertical direction (groups). In the *lower* half are the elements with low electro-potential, complex spectra, colored ions and tending to form complex double salts, the general properties of the elements being more pronounced in the horizontal direction (periods).

On the *left* side of the table are the electro-negative elements, those of the upper half forming strong acids, those of the lower half weak oxy-acids.

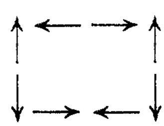
On the *right* side of the table are the electro-positive elements, forming bases, oxysalts, sulfides, etc.

The *center* of the lower half is occupied by the amphoteric elements forming weak acids and bases, many complex compounds and double salts, many insoluble and mostly colored compounds.

A very striking point, however, is, as already mentioned, that the *simi-*

larity among the elements in the upper half is in the vertical direction, and in the lower half in the horizontal direction. This justifies the use of the expressions group-relation and period-relation. We may speak, therefore, of the *group-relation* of Cr, meaning its relationship to Mo and W, and to a less degree to S; and of the *period-relation* of Cr, indicating its connection to Mn, Fe, etc. From the fact that the elements of the sub-periods III′, IV′ and V′ have many polar numbers in common, *e. g.*, 2 and 3 in III′, 2 and 4 in IV′, etc., we may deduce an explanation for their similarity.

Another advantage of the table is that the numerical values expressing certain properties (melting point, atomic volume, etc.) are easily inserted and that the relationship between these factors is much better shown, for the elements are better separated (Mn, for example, does not come between Cl and Br as in the old table) and the direction of the increase or decrease of the values can be expressed by arrows placed on the border of the table. I have prepared such tables for a very large number of different properties, and find that the arrows indicate in a very clear way the general trend. Thus the scheme for the specific gravity would show the following arrows on the border of the table:



indicating clearly that the alkali metals are the lightest, and the platinum metals the heaviest.

In order to place the isotopes of the radioactive elements it will be necessary to place the top row from lead to thorium at the bottom of the table, extending the row on both sides, so as to include the elements with atomic numbers 81 to 92. Under this line the system of the radioactive elements can be placed, which then will form a kind of appendix to the main table.

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THE COLLOIDAL PRODUCTS OF THE REACTIONS BETWEEN POTASSIUM DICHROMATE AND STANNOUS SALTS.

BY J. C. WITT.

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When normal potassium dichromate solution is added to normal stannous chloride solution in equivalent proportions, brownish and greenish blue gelatinous masses are formed. At one point during the addition the entire mixture becomes a gel and a considerable rise in temperature is noted. When all the dichromate has been added, the brownish tinge gradually disappears, and in time the whole reaction mixture becomes