8. Addition of methane and carbon dioxide was shown. A caramel- or wax-like solid was deposited on the wall.

9. In the oxidation of methane by oxygen, mixtures with excess of either component gave approximately the same $-M/N$ ratio as the stoichiometric mixture, showing the ions of both components to be equally effective in the chemical reaction.

WASHINGTON, D. C.

[CONTRIBUTION FROM THE BUREAU OF STANDARDS, UNITED STATES DEPARTMENT OF COMMERCE]

A METHOD OF ESTIMATING ATOMIC WEIGHTS WITH THE AID OF THE PERIODIC LAW

By Edward W. Washburn[1]

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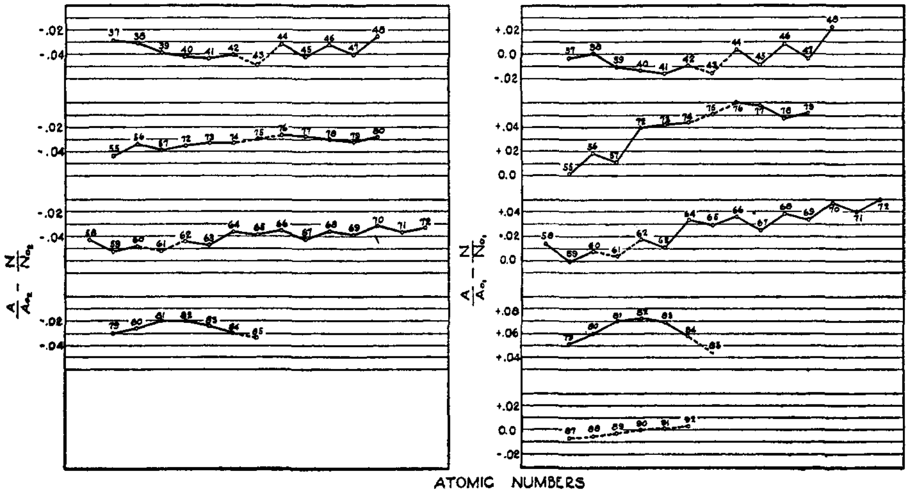
A relationship between atomic weight and atomic number proposed by Harkins and Wilson[2] holds with a fair degree of accuracy for most of the elements in the first three rows of the periodic chart. For the elements beyond nickel, however, the relation fails, probably in part at least because many of these elements are mixtures of several isotopes. All of the elements whose atomic weights have not yet been determined fall in the last five rows of the periodic chart.



The following graphical method, when applied to these elements, exhibits a relation between atomic weight and atomic number which can apparently be applied with considerable confidence to the estimation of most of the missing atomic weights. The method is as follows.

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[2] Harkins and Wilson, This Journal, **37**, 1386 (1915).

The ratio of the atomic weight of each element to that of the next preceding (also succeeding) zero-group element is computed. The ratio of the corresponding atomic numbers is also obtained and the difference between these two ratios is plotted against the atomic numbers of the elements. These graphs for Rows 1, 2, 3, 4 and 6 of the periodic chart are rather irregular and could not be used with much confidence for the prediction of atomic weights. Fortunately, there are no unknown atomic weights for the elements in these rows of the chart. For the remaining rows of the chart the graphs exhibit a considerable degree of regularity and the differences between the two ratios A_x/A_0 and N_x/N_0 become smaller as the atomic numbers increase. Indeed, for the last row in the chart this difference is close to zero. These graphs are shown in the accompanying figure. The estimated loci of the points for the elements whose atomic weights have not been experimentally determined are shown on the dotted portions of the graphs. From these estimated points it is obvious that the missing atomic weights can be computed by reversing the calculation. The "best" values thus estimated are given in Table I.

TABLE I

ESTIMATED ATOMIC WEIGHTS

Symbol	Name	At. no.	At. wt., estimated
Ma	Masurium	43	97.5? (or 98.8)
Il	Illinium	61	146.0
Re	Rhenium	75	187.4
	Eka-iodine	85	212
	Eka-cesium	87	223
Ac	Actinium	89	229
Pa	Proto-actinium	91	234

WASHINGTON, D. C.

[CONTRIBUTION FROM THE RESEARCH LABORATORY OF ORGANIC CHEMISTRY, MASSACHUSETTS INSTITUTE OF TECHNOLOGY, No. 9]

ABSORPTION COLORS OF THE SECOND ORDER

BY JEAN PICCARD

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Some years ago Piccard and Kharasch isolated *p*-nitrosotriphenylamine and explained its orange color as a color of the second order. We may here briefly review the theory of absorption colors of the second order. As a rule, any increase of the molecular weight of a colored organic compound shifts its color in a definite direction, that is, from yellow to orange to red to violet to blue, and finally to green. If we increase the molecular weight still more, this green color turns to yellowish-green and then to yellow. As this phenomenon reminds us of the interference colors of the

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[1] Piccard and Kharasch, THIS JOURNAL, 40, 1074 (1918).