than $0^{\circ}.05$, and between 0° and 100° the maximum difference is only a little over $0^{\circ}.01$ at 70° . Our formula represents therefore very closely the experimental results.

ELASTIC PROPERTIES OF BISMUTH WIRES.¹

BY K. E. GUTHE AND J. E. HARRIS.

A FEW years ago one of the authors found that platinum-iridium wires, containing a large percentage of iridium, show an abnormal behavior when subjected to a torsional strain. Further experiments with wires of different material have shown that this exceptional behavior is not restricted to platinum-iridium wires, but that it is found in wires of other material, and that it is especially pronounced in the case of bismuth. The results of a preliminary set of readings, taken with a bismuth wire, 458 mm. long and 0.28 mm. in diameter, are given in the following table.

TABLE I.

No. of Swings.	Amplitude.	Amplitude.	Period.
1	91.7	79.9	3.950
5	58.2	74.1	.948
10	48.9	68.2	.947
15	35.6	55.7	.937
20	26.6	48.9	.932
25	19.7	35.6	.919
30	15.0	26.6	.909
35	11.9	19.7	.896
40	9.2	15.0	.891
45	7.2	11.9	.886
50	5.6	9.2	.879
55	4.5	7.2	.872
60	3.4	5.6	.870
65	2.6	4.5	.857
70	2.0	3.4	.853
75	1.5	2.6	.850

As in the case of platinum-iridium wire, reported on by Guthe and Sieg² the period decreases considerably with decrease of amplitude, the rate of decrease being most pronounced at small amplitudes. In the case of bismuth wire the internal friction is, however, very much larger. During 75 vibrations the amplitude decreased from 91.7 to 1.5 degrees, while in the case of the 40 per cent. platinum-iridium wire³ it required nearly 400 vibrations, before

¹Abstract of a paper presented at the Chicago meeting of the Physical Society, November 26, 1910.

²Guthe and Sieg, *PHYS. REV.*, 30, 610, 1910; Sieg, *PHYS. REV.*, 31, 421, 1910.

³*PHYS. REV.*, 30, 624, 1910.

the amplitude fell from 83.1 to 3.93 degrees. The logarithmic decrement for the bismuth wire is between 0.03 and 0.02, or six times larger than that of the platinum-iridium wire.

On account of the small number of swings it is impossible to calculate the period from a set of 20 or 40 swings, as was done in the former case, and therefore, no great accuracy can be claimed for the periods, as given in the above table. We hope to overcome the difficulty by employing in our further work with bismuth wires an automatic device for marking the exact time of the passage of the moving system through the position of rest.

THE SPECTRUM OF THE SPARK UNDER PRESSURE AND AN APPLICATION OF THE RESULTS TO THE SPECTRUM OF THE CHROMOSPHERE.¹

BY HENRY G. GALE AND WALTER S. ADAMS.

A CONSIDERABLE number of photographs of spark spectra under pressure were taken by us last spring at the spectroscopic laboratory of the Mt. Wilson Solar Observatory.

The spark was generated by a 5-kilowatt transformer, and differences of potential up to 60,000 volts were available. No self induction was employed, and a considerable amount of capacity was used in the secondary circuit. Most of the photographs were taken in the second order of a 7-inch Michelson grating, mounted in a 30-ft. Littrow spectrograph. The pressure varied from 2 to 15 atmospheres.

The first photographs obtained were of titanium in the region from $\lambda 4250$ to $\lambda 4650$. At pressures of 5 or 6 atmospheres practically all of the arc lines were reversed, and all of the enhanced lines remained bright, or showed only a faint trace of reversal which did not increase appreciably up to 15 atmospheres. A similar result was obtained to the violet of $\lambda 4250$. The enhanced lines were practically the only ones to remain bright. In the green, yellow and red, however, a number of arc lines were found which did not reverse. This is in agreement with the well-known general result that the tendency of arc lines to reverse increases toward the violet.

A similar series of photographs with iron and chromium gave in general the same result, except that the arc lines did not reverse so readily at the lower pressures. In no case were the enhanced lines reversed at the pressures used.

In the case of cobalt, a plate from $\lambda 5000$ to $\lambda 5400$ taken at a pressure of 8 atmospheres showed no reversed lines, although iron, titanium and chromium showed many reversed arc lines in this region.

It has long been known that the enhanced lines are particularly prominent

¹Abstract of a paper presented at the Chicago meeting of the Physical Society, November, 26, 1910.