

The Effect of Pressure upon Arc Spectra. No. 2.—*Copper*,
 λ 4000— λ 4600.

By W. GEOFFREY DUFFIELD, D.Sc.

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(Abstract.)

A direct current arc from 100-volt mains was formed between copper rods within a pressure cylinder designed by Professor J. E. Petavel, F.R.S. The light passed through a glass window, and, after reflection from two mirrors, was focussed upon the slit of the large Rowland grating spectroscope in the Physical Laboratories of the Manchester University. The apparatus and method of using it have been described in a previous paper.*

The spectrum of the copper arc in air has been photographed in the region $\lambda = 4000$ to $\lambda = 4600$ Å.U. at the following pressures: 5, 10, 15, 20, 30, 40, 50, 60, 70, 80, 100, 125,† 150,† 203† atmospheres (excess above 1 atmosphere).

I. *Broadening.*

Within the region $\lambda\lambda$ 4000—4600 :—

1. All lines are broader under high pressures than under atmospheric pressure.
2. The broadening increases with the pressure; it has not been determined if the increase is continuous and linear with the pressure.
3. The broadening of all lines is unsymmetrical, being greater on the red side.
4. The amount of broadening is different for different lines.
5. Two types of broadening have been observed: some lines at first become faint and hazy, almost resembling bands, and are completely dissipated under higher pressures (series lines); others, though much broadened, remain well-defined lines (non-series lines).
6. No simple relation has been found between the width of a line under pressure and its original intensity.
7. The intensity curves of the sharp lines under pressure are steeper towards the violet than are those of the nebulous lines. The sharp and nebulous lines retain their characteristic "hard" and "soft" appearances throughout.

* Duffield, 'Phil. Trans.,' A, vol. 208, p. 111 (1908).

† Added October 19, 1908.—G. D.

8. The nebulous and sharp non-series lines broaden to about the same extent; for the well-defined lines, the width may be as great as 12 Å.U. at 203 atmospheres.*

9. The broadening at first appears to increase more rapidly than the displacement, making measurements at low pressures less accurate than those at high pressures.

II. *Displacement.*

Within the region $\lambda\lambda$ 4000—4600:—

1. Under pressure, the most intense portion of every line is displaced from the position it occupies at a pressure of 1 atmosphere.

2. The displacement is in the direction of greater wave-length.

3. The displacement is real, and not due to unsymmetrical broadening, *i.e.*, the line is broadened about a displaced position.

4. The displacement of each line is, within the limits of accuracy of the experiments, continuous and linear with the pressure.

5. The rates of increase of the displacement with the pressure are different for different lines.

6. The lines belonging to the first and second subordinate series have greater displacements than the non-series lines. Their great width precludes accurate measurement.

7. The displacements of non-series lines are functions of their wave-lengths. The evidence indicates that they vary with a power of the latter, at least as great as the third and possibly as great as the sixth.

8. There is some reason to believe that there are two values for the displacement of a line at one and the same pressure.

9. The mean displacement of the non-series lines is 12.2-thousandths of an Å.U. per atmosphere. The largest displacement measured is a little more than 2 Å.U. at 203 atmospheres.*

III. *Reversals.*

None of the copper lines within this region showed any signs of reversal under pressure.

IV. *Relative Intensities.*

Within the region $\lambda\lambda$ 4000—4600:—

1. Changes in relative intensities of lines occur under pressure.

2. Those belonging to either the first or second subordinate series vanish at

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about 40 atmospheres and do not reappear as the pressure is increased (obliterated lines).

3. Members of the first sub-series become at low pressures faint and hazy, almost resembling bands, and are at higher pressures dissipated. There is, however, always a marked cloudiness in the neighbourhood of their original position.

4. Members of the second sub-series gradually diminish in intensity without abnormal widening. No cloudiness is distinguishable near their original position.

5. Of the non-series lines, those that are nebulous are strengthened relatively to those that are sharp.

6. Lines strengthened under pressure do not correspond with those given by other workers as "enhanced" lines.

V. *Brightness of the Arc.*

The brightness of the copper arc increases enormously with the pressure of the surrounding air.
