AN EXTENSION TOWARD THE ULTRA-VIOLET OF THE WAVE-LENGTH-SENSIBILITY CURVES FOR CERTAIN CRYSTALS OF METALLIC SELENIUM.

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In a recent paper[1] we published a number of characteristic wave-length-sensibility curves for certain crystals of metallic selenium. We were unable with the apparatus then employed to carry our curves below wave-length .50 μ with any great degree of certainty, on account of the small amount of energy available from the Nernst glower in this region. We have recently employed a right angled arc, focusing the positive crater of the arc upon the slit. By means of this intrinsically brighter source we have been able to go to the limit of Hilger's monochromatic illuminator, .38 μ. A new instrument that will enable us to work in the ultra-violet region has been ordered, and as soon as it is received we propose to explore these crystals still further into this region. On account of the delay that may be involved at this time in getting this instrument we have thought it best to publish the work as far as we have carried it.

The apparatus employed was the same as that described in our previous paper[2] with the two exceptions of the arc light mentioned above, and a new Leeds and Northrup galvanometer substituted for the Siemens and Halske Panzer galvanometer. The arc light was much less steady than the Nernst glower, but by careful adjustment and attention we were able to get results that were sufficiently reliable to represent without question the true character of the curves. The D'Arsonval galvanometer was only slightly below the Panzer galvanometer previously used in working sensibility, but was vastly more steady in its action. Its resistance, and critical damping were each about 12 ohms, its sensibility 324 megohms, or 14.5 mm. per microvolt. The period was 7.3 sec. Adjustment for equal energy was made with a thermopile in just the same manner as in our previous work. Again the question whether equal energy falling upon these brilliantly reflecting crystals means equal absorbed energy among the various wave-lengths must be held in abeyance until some of their optical properties can be determined.

[1] Phys. Rev., 4, 1914, p. 507, 1914.

[2] Loc. cit.

The curves published in the former paper, to which this paper is an addendum, indicated in every case that the light sensibility was increasing as one proceeded below wave-length .50 μ. The indications pointed not only to an increase, but to a pretty sharp increase in sensibility. Our present work was done in the hope of locating a maximum in this region, but as far as we have gone the curves still rise, indicating the maximum, if there be any at all to be further into the ultra-violet. In the accompanying figure will be noted characteristic curves for two types of

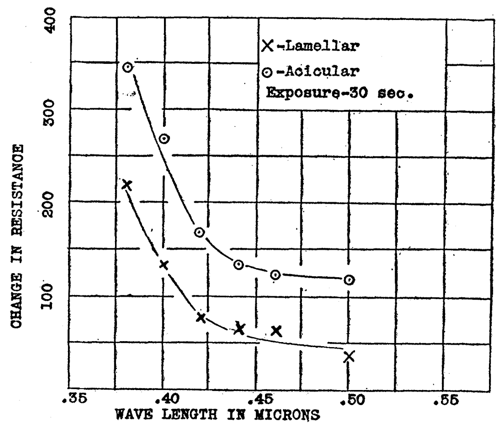

Fig. 1.

crystals, the lamellar and the acicular.[1] The former crystal was clamped between two conducting jaws and its thin edge was illuminated. The other crystal was similarly clamped, and was illuminated along its whole length a distance of about 7 mm. In both cases the action was what we called "direct," as distinguished from "transmitted" action. In other words, in this case, the light fell upon the conducting portion of the crystal. It should be noted that the energy used in these last experiments was about ten times as large as the energy employed in the work already referred to.

While it is unwise to make too close a comparison between the results from these crystals and those of work done on ordinary selenium cells,[2] it is interesting to note that although many of the characteristics are similar particularly with respect to light of the longer wave-lengths, there seems to be more of a difference when one deals with the shorter wave-lengths. For example we have thus far found no crystal that did

[1] For descriptions of these crystals, and for other references, see the paper previous to this; loc. cit. Also PHYS. REV. N. S., Vol. 4, p. 85, 1914.

[2] PHYS. REV., 4, 1914, p. 48.

not indicate an increase of sensibility toward the ultra-violet, whereas many of the cells tested showed a falling off in sensibility in this region. Nicholson[1] has carried some ordinary cells down to wave-length .23 μ, and has found a steady decrease in sensibility with the shorter-wave-lengths. As we noted above, however, there is no great value in making too close comparisons, because the peculiar mat, grey surface of the common selenium cell may react toward light in a manner decidedly different from that of these brilliant crystals.

It is interesting, even at the cost of going over old ground, to speculate upon what is going on in these crystals under light action. The increase in electric action toward the ultra-violet suggests a photo-electric effect. If that is the case then it becomes difficult to account for the maximum that appears in various places toward the red end of the spectrum. In the broad sense it is of course a photo-electric effect, only in this case it is not limited to the surface but takes place throughout the body of the crystal. And it must be remembered that it takes place through the crystal not only in the path of the light, but the action spreads to a distance, as we have already shown,[2] even going from the tip of a spine down into and through the main stem of a crystal cluster. If we are dealing here with the ordinary photo-electric effect, then we should find, when we proceed into the ultra-violet, no maximum whatever, but rather a steady increase in sensibility. It may be that there is a fundamental curve for the light-electric effect on the basis of Planck's theory which will show a steady increase in proceeding from the long to the short wave-lengths, and that the various maxima found in between will find their explanation in the common optical properties of these crystals, such as selective absorption, selective transmission, body color, etc. The fact that these peculiar maxima have thus far made their appearance in the red region of the spectrum, coupled with the fact that the color transmitted through these crystals is reddish in color may be of importance in the final solution. Work along this line is to be prosecuted at once.

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[1] PHYS. REV., 3, 1914, p. 1.
[2] Phil. Mag., 28, 1914, p. 497.