Fatigue in Selenium Rectifier Cells

THE effect described by Mr. J. S. Preston in his letter in *Nature* of June 3[1] may be connected with the increased departure from linearity of response which Dr. W. R. G. Atkins and I[2] found to occur in a number of these cells when illuminated by light of wave-length greater than about 0·66 μ. We were interested in the use of these cells to measure daylight, especially under water, where very large changes of illumination occur and optical methods of varying the exposure of the cell are very inconvenient. Long range and large maximum illumination were therefore essential, and the photometer bench used gave a range of 1 to 725. A filament lamp behind a water cell 4·4 cm. thick gave a maximum illumination estimated at some 15,000 lux when no colour filter was used. Schott *BG* 12, *RG* 1 and *RG* 5, Corning Green and Zeiss 966/8 filters, singly or combined, enabled different spectral regions to be tested. Fatigue effects were reduced to the utmost by keeping the cell in the dark except for the few seconds needed to balance the Campbell-Freeth circuit by which the current was measured. The comparative steadiness of the balance seemed to show that in this case fatigue was unimportant. We did not notice enhanced fatigue in red light, possibly because we expected a small fatigue effect due to the warming of the cell circuit by the comparatively intense deep red and near infra-red radiation transmitted by the red filters.

Under these conditions we found that for a Weston cell and light of wave-length below about 0·66 μ, the sensitivity, as measured by the Campbell-Freeth zero resistance circuit, was nearly constant up to about 100 μamp., showing, in fact, a small rise with current up to a few microamperes, as found for some cells by other workers. For wave-lengths above 0·66 μ, however, the sensitivity commenced to fall at about 1 μamp., and had fallen by 15 per cent at 100 μamp. Another Weston cell showed a similar effect, and eight electro cells each showed it to an enhanced degree.

Adding to the resistance of the circuit of course increases the departure from linearity, but we were somewhat surprised to find that for each cell tested the inclusion of 1,000 ohms in the circuit produced a fall in current depending only on the initial current, and not at all on the colour of the light to which it was due. We accordingly suggested that the red light effect was of a primary nature, and due to the existence in the selenium cells of a photo-electric threshold near 0·66 μ, causing a tendency to saturation in the current produced by intense illumination of longer wave-lengths.

The increase in the transparency of selenium near 0·64 μ may be connected with a reduction in the number of photo-sensitive and hence light-absorbing electrons as we passed through that spectral limit. This limit, as found by Mr. Preston for the fatigue effects, is so close to our approximate limit for the curvature effect that it seems probable that the two effects are closely connected.

H. H. POOLE.

Royal Dublin Society. June 16.

[1] *Nature*, **153**, 680 (1944).
[2] *Sci. Proc. Roy. Dub. Soc.*, **22**, 393 (1941).

THE results to which Dr. Poole refers seem certainly to be related to the fatigue effects which we have noticed. During a recent visit to this Laboratory, Dr. Atkins directed our attention to these results and we discussed them in some detail.

Taken in conjunction with our own, they point to a close correlation between various properties of the cells, as Dr. Poole suggests, and there now seems good reason to believe that the basic common factor is the existence of a photo-electric, and an associated transparency, threshold in the neighbourhood of 0·66 μ or 0·64 μ. The way in which this factor enters into the action of the cell is certainly of practical interest and may be of fundamental importance. Our suggestion that the comparatively deep penetration of red light into the selenium results in a kind of space-charge retarding the emission of electrons from the deeper layers is, of course, only tentative; but such a mechanism would provide for both the non-linearity and the fatigue effects together, provided the space-charge is not built up instantaneously. This supposition recalls also the kind of fatigue exhibited by the older resistance type of cell.

The subject of fatigue merits careful investigation and we hope to carry out further work upon it.

J. S. PRESTON.

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July 4.

Relation between Dissonance and Context

IN an attempt to meet some of the criticisms made of our previous work on the effect of musical context on dissonance[1] a new experiment has been carried out.

A single 'dissonant' chord, the seventh on the sub-dominant (when in *C* Major), second inversion ($c_0\ a_0\ f'\ e''$, according to the tone nomenclature given by Myers[2]), was used throughout as the chord to be investigated, and will be called the 'test chord'. Mr. C. G. Gray suggested this chord, and offered several contexts for it. A number of other passages in which it appeared were found in well-known works, with an additional passage composed by Mr. Gray and slightly altered by the writers. Altogether there were fourteen passages: two by Chopin, one by Weinberger, nine by Greig, one from a traditional air and one by Mr. Gray. The test chord, though, of course, it was not always in *C* Major, did always consist of the same four identical notes.

The passages were played on the piano to fifty students (43 women and 7 men). The aim of the experiment was explained beforehand, and the subjects were asked to avoid judgments of liking and disliking and to concentrate upon consonance and dissonance. As each passage was played by one of the experimenters (P. A. D. G.), the other (R. W. P.) raised his hand when the test chord was sounded and then immediately lowered it again. Each passage was played over in this way often enough for all the subjects to be satisfied that they had identified the test chord and rated it on a scale +3, +2, +1, 0, −1, −2, −3, from very consonant to very dissonant.

The subjects had all received instruction in the psychology of sound and had done the Oregon and other music tests. They also filled in a questionnaire on degree of musical interest. Their average score for on the Oregon test was 77/96, and the scores of this test correlated +0·576 ($p<0·01$) with the questionnaire results converted into a quantitative form. These points show that the musical ability of the group was high. The subjects were astonished