NOTE ON PHOTO-ELECTRIC PHENOMENA

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The purpose of this paper is to attempt a clear-cut differentiation of the various photo-electric or photo-sensitive phenomena. The reason for this effort is an apparent inconsistency on the part of sundry investigators and writers in the usage of terms common to this field.

According to Allen[1], the term *photo-electricity* denotes a change in the state of electrification of a body produced by the action of light. This definition is quite in keeping with the original description of the effect by Hallwachs[2].

Allen[3] argues that in accordance with modern electrical theory we regard light as an electro-magnetic disturbance; and, a change in electrification as due to the addition or removal of negative electrons. From this standpoint, a photo-electric change is equivalent to the liberation of negative electrons under the influence of electro-magnetic waves. Such a process is, therefore, of fundamental importance, not only in those cases where a change of electrification is readily detected, but also in connection with many other phenomena where the observed effect is of a secondary character. He concludes that amongst the latter, we may include the change in the electrical resistance of a body due to illumination, fluorescence and phosphorescence, and all photo-chemical transformations.

Starling[4] states that the Hallwachs[5] phenomenon is only one case of the liberation of electrons when light falls upon matter and that this photo-electric phenomenon has been shown to be connected with those of fluorescence and phosphorescence, as well as with that of chemical changes occurring in the photographic plate.

Thomson[6], Crowther[7], and Richtmyer[8] practically concur with the interpretations of the previously mentioned writers, but nowhere do any of these authors draw a sharp distinction between the modes of construction and the characteristic responses of those devices yielding the secondary effects quoted from Allen.

The advantage of such distinctions appeals to the writer who on a previous occasion drew attention to them in a popular article[9]. A case in point illustrating the interchange of photo-electric terms and an apparent lack of convention in the matter is the following extract from Coblentz[10]: "The term *photo-electric* was ordinarily used interchangeably with actino-electric to designate a direct transformation of light (thermal radiation) into electric current. In this paper the term photo-electric is applied to the change in resistance which a substance exhibits when it is subjected to an externally impressed e. m. f. and exposed to thermal radiation."

In order to expedite the discussion, it may be well to refer to original sources pertaining to the respective phenomena classified under the general term of photo-electricity. This will be done in a chronological order.

The first of these so-called secondary effects is the thermo-electric or Seebeck[11] Effect. Here a current flows in a circuit consisting of two different metals when a difference of temperature is maintained between their junctions, an example of which is the action of the thermopile when subjected to thermal radiation.

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Another is the photo-chemical or Becquerel[12] Effect in which certain substances when used as the two poles of a voltameter containing an electrolyte show a difference of potential when one plate is in darkness and the other illuminated. An interesting example of this effect is contained in a report on "A Cuprous Oxide Photo-chemical Cell," by Case[13].

A third is the actino-electric effect attributed by Coblentz[14] to Hankel[15] who more than eighty years ago used this term to designate the e.m.f. generated in a crystal (for example quartz) when connected with an electrometer or galvanometer and exposed to sunlight, daylight or an electric arc. Incidentally, Allen[16] is inclined to bestow this honor upon Kolzareff[17] who discovered the same effect in molybdenite considerably later.

The fourth is the photo-resistant effect discovered by Smith[18] who being desirous of obtaining a suitably high resistance for use with submarine cables, instituted certain experiments on selenium in the course of which remarkable fluctuations of current were observed when the selenium was exposed to light. This effect is by no means confined to selenium but is shared by various other substances of which stibnite, molybdenite and cuprous oxide are representative.

Finally, we arrive at the photo-electric effect proper, also known as the Hallwachs[19] Effect defined in a previous quotation from Starling. Standard types of photo-electric cells such as are being used today in the talking pictures and in television are, with slight modifications, the Hughes[20] and the Kunz[21] cells. The theory and evolution of photo-electricity as a whole are to be found in all advanced texts on modern physics, especially in the classic texts of Hughes[22] and of Allen[23].

The writer concludes, therefore, that owing to the decidedly characteristic construction of those devices generally known as photo-electric cells, their peculiar disposition and response, it would be well for investigators and writers in this field to refer directly to what Allen[24] styles as the secondary effects and call a selenium cell a photo-resistant cell and its effect a photo-resistant effect; and, so with all the remaining secondary effects and their respective cells, notwithstanding that in the ultimate they are all photo-electric effects.

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