surface of the skin. This is carried to an extreme in the row of organs present on each side of the laterally compressed upturned tail. Here the organs lie with their axes almost parallel to the surface of the skin.

The complex lantern-like structure of each individual organ seems designed to throw out a parallel beam of light, and to prevent scattering of the rays; the arrangement of the axes of all the organs parallel to the median vertical axis of the fish, seems to aim at precisely the effect described above, namely, that the luminescence will only shine upon objects immediately beneath the ventral surface.

The mouth of Spinax is situated remarkably far behind the tip of the snout, so that Spinax can obviously only seize objects immediately beneath (in the relative sense) its mouth. But it is only when an object is immediately below the ventral surface of the fish that the light from the luminous organs flashes fully upon it. One may therefore suggest that the sudden flash of light, at the moment of attack, may cause the prey of Spinax to hesitate for just that fraction of a second in which the mouth can make a successful snatch.

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An Optical Paradox.

A PARADOX propounded at a meeting of the Physical Society may be of interest to a wider scientific circle.

Suppose that we have two lamp sockets, connected to perfectly steady electric supplies, clamped in fixed positions on an optical bench; exactly midway between these sockets is a photometer, also clamped. The photometer field, we will say, is divided by a fine vertical line into two parts, that on the left of the line receiving light only from a lamp placed in the socket on the left side of the observer, the part on the right of the dividing line receiving light only from a lamp placed in the socket on his right. Assume also that we have a series of lamps A, B, C, D . . . Z proceeding in finite steps from a lamp A, which emits at a definite rate light of a certain quality, to a lamp Z, which gives at some other rate light of some other quality.

We shall not be concerned with the ways in which the output of these lamps is to be measured quantitatively or qualitatively. Fechner's law applies to visual sensations, and we can therefore construct our finite sequence of lamps connecting any two given lamps A and Z in such a way that any two consecutive lamps of the series, if placed in the two sockets on our bench, will so illuminate their respective halves of the photometer field that the most critical observer can detect no difference between them. In other words, the visual sensations corresponding to the two halves of the field are identical. To say that the sensations differ by an amount so small that the observer is unconscious of the difference is to quibble.

Let us now suppose the lamps compared by an observer who is not subject to fatigue or other disturbing factor. We start with lamp A in the left socket and lamp B on the right. Each gives rise to the same sensation, which we will call S. Without in any way disturbing the system to the right of the photometer, we replace lamp A by lamp C. The sensations derived from the two lamps B and C are again identical, and since the system on the right is not in any way altered the new sensations are again exactly represented by S. We now leave the left-hand system alone and replace B by D; the previous argument applies without change, and the sensations are still S. The procedure indicated can evidently be carried as far as we like, and leads to the conclusion that any two lamps, A and Z, placed at the same distance from the photometer give rise to exactly the same sensation S. In other words, their candle power and their colour are the same, a conclusion which is absurd.

The significance of the paradox lies in the fact that the error in the argument arises from the neglect of a consideration widely ignored in scientific work. It should be observed that the experimental principles adopted, the use of a null indication and of simple substitution, are those most approved for precise measurements.

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A Simple Form of Photo-electric Photometer.

DR. N. R. CAMPBELL (*Phil. Mag.*, **111**, pp. 945, 1041; 1927) has described a new method of using a gas-filled photo-electric cell by which small illuminations can be measured by the use of a telephone only. This method is, however, only applicable to gas filled, and not to vacuum, cells; and for accurate measurements of strong illumination the latter are much more trustworthy. It is possible by using the well-known phenomenon of the intermittent discharge through a neon lamp to employ a somewhat similar method in the case of a vacuum cell. The circuit necessary is very simple. The photo-electric cell and the neon lamp are connected in series with a high tension battery of suitable voltage, and the neon lamp is shunted with a condenser. Under these conditions intermittent flashing will occur in the lamp when the photo-electric cell is illuminated, and the frequency of the flashes will increase with the illumination. It is accordingly only necessary to time this frequency to obtain a measure of the illumination. To do this it has been found more convenient to insert a telephone in series with the shunting condenser, and to count the clicks heard in it.

Some preliminary tests of the arrangement have been carried out, and they have shown that while the method is decidedly hopeful, it will need careful investigation before it can be considered reliable. The leakage current through the neon lamp before flashing occurs evidently limits the lowest illumination that can be detected. In the commercial Osglim lamp I have employed, this current appears to be unduly large, possibly due to insufficient insulation in the cap of the lamp. To obtain the best results it will probably be necessary to use special neon tubes. Leakage in the shunting condenser may also be troublesome. The sensitivity of the apparatus can easily be altered by using a variable condenser, and hence lights of very different intensities measured. It has been found, however, that the condenser should not be made too small, as then the flash discharge tends to become irregular.

If the method proves itself capable of yielding consistent and trustworthy results, it will undoubtedly be very useful for what we might call field measurements of daylight illumination with photo-electric cells. In these cases it is always inconvenient, and sometimes impossible, to use either a sensitive galvanometer or electrometer, and the only alternative is to employ some telephonic method such as has been developed by my brother, Dr. H. H. Poole (*Scientific Proc. Royal Dublin Society*, vol. 18, No. 9; 1925), in connexion with the measurements of