

The "poundal" system is equally objectionable theoretically (witness Prof. Lodge's formula  $s = \frac{w}{v}$ ), and is not in practical use.

Then why introduce it? C. S. JACKSON.

**Conductorless X-Ray Bulbs and Tubes.**

IN October 1896 (NATURE, vol. liv. p. 594), a description was given by me of an exhausted bulb used in conjunction with a Tesla coil which gave X-rays and its photographic effects. Since these experiments I have found other phenomena, which throw some light on the relative positions of the conductor carrying the oscillations and the greenish fluorescence within the bulb or tube. The relationship is shown in the following diagrams:—

(1) A B is the conductor, with its axis parallel with O X, carrying the oscillating current of the Tesla secondary coil; S S the exhausted sphere, F D E a ring of greenish fluorescence, the plane of the ring being at right angles to the axis of the conductor A B. The X-ray effects were strongest at D, a point in O Y furthest from the conductor A B. The limits of the position of the edges of the fluorescence were easily traced by means of a minute fluorescent screen, placed at the end of a vulcanite tube, furnished with a cup-shaped end to cover the eye.

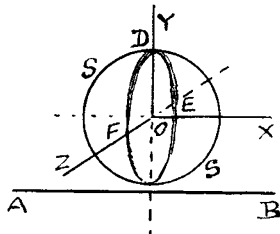


FIG. 1.

When the sphere was rolled, or moved parallel with itself along the length of the conductor, the plane of the glow-ring, F D E, kept its original position and moved perpendicular to the conductor. I have not been able to obtain the effects from an ordinary induction coil giving an 8 cm. spark only with the Tesla coil.

An exhausted tube was next placed within an open coil carrying the Tesla oscillations; the following beautiful effects were produced.

A B, exhausted tube; C C C, the spiral conductor; D D D, the glow in the form of a spiral within the tube. When the glass tube was about 4 mm. internal diameter, and the conductor, a gutta-percha covered copper wire, touched the glass, the spiral glow was very bright, and the glass became warm.

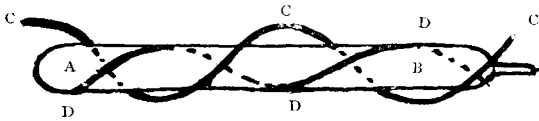


FIG. 2.

If a cross section be made through the tube and wire at right angles to the axis of the tube, a point in the glow is situated 180° from a point in the conductor, the section of the axis, the central point, being taken as the origin. The Tesla spark in air was 5 mm. long, and the coil formed a part of the spark circuit.

Oxford, January 14. FREDERICK J. SMITH.

**Patterns produced by Charged Conductors on Sensitive Plates.**

IN reply to the request of Mr. J. P'Anson for a reference to any former observations on the interesting effects described in your current number, he will find in the B.A. Report for 1888, and more fully in the *Philosophical Magazine* for December of that year, an account of the phenomenon as observed by the present writer, using cut-out patterns of tinfoil as conductors. This action of electrified conductors in contact with the photo-

graphic film was subsequently employed in a refined way by Rev. F. J. Smith, in making very beautiful and interesting prints from electrotype and other printing blocks. His results were shown at a conversazione of the Royal Society on May 10, 1893.

My own paper was chiefly occupied with a description of the figures produced by allowing sparks from an induction coil to play in various ways over photographic plates; and now that induction coils have become so much more widely distributed, it seems worth while to again draw attention to the exceedingly beautiful and interesting effects easily produced in this way.

A very fine set of prints from similar spark traces was exhibited by Mr. A. A. C. Swinton, at the Royal Society's conversazione of June 15, 1892.

Belfast, January 22. J. BROWN.

**The Problem of the Sense Qualities.**

(1) IN his very friendly notice of my "Outline of Psychology" (NATURE, December 10, 1896), Mr. W. E. Johnson points out what he takes to be a fallacy underlying the calculation of the number of possible sensation qualities in that and other textbooks. I believe with Mr. Johnson that the qualitative series is in many cases (not all: *cf.* taste, *e.g.*) continuous. But I do not think that this makes the calculation of distinguishable qualities fallacious.

Mr. Johnson's argument is briefly as follows:—Let A B C D be stimuli of the same physical continuum (*e.g.*, wave-lengths), whose values are such that the sense qualities corresponding to A and D are just noticeably different. Then we have:—

Stimulus	...	...	...	A	B	C	D
Sensation	...	...	...	a	[b]	[c]	d;

and the syllogism runs:—

a is not d,  
b is d,  
∴ a is not b.

But by hypothesis, a is b, being indistinguishable from it. Hence to make difference = distinguishableness in calculation leads to a logical fallacy.

If now it were a case of diversity in logical predicate *vs.* identity in experience, the psychologist would be found to decide in favour of experience. But I think that the whole syllogism is erroneous. As a matter of fact, going from left to right, we have the series:—

Stimulus	...	...	...	A	B	C	D
Sensation	...	...	...	a	a	a	d

and, going from right to left, the series:

Stimulus	...	...	...	A	B	C	D
Sensation	...	...	...	a	d	d	d

from which the only conclusions are:—

Some a is not d,  
Some a is d, . . .

*i.e.*, two particular propositions. It is of the very essence of the just noticeable difference that it is cognised under certain conditions, and not under all.

So far, then, the fallacy turns out to be imaginary. There are no sensations b and c, qualitatively distinct from a or d. Nor can there be, whatever value of stimulus be taken as starting-point for the determination. An observer working with stimuli B C D E . . . would get the sensation series *b e i m* . . . which would be qualitatively indistinguishable from the series *a d h l* . . .

Calculation of qualities by arithmetical progression presupposes, of course, a constancy (found as in tones, or calculated as in colours) of the absolute difference limen. Weber's law holds only of sensation intensities, which I expressly decline to calculate (p. 70). There is one qualitative series in which a uniformity resembling Weber's law obtains: the black-white series. But this series is in many respects anomalous, its qualities seeming to have the function of visual intensity; and neither its physiology nor its psychology is at present very satisfactory. (For the calculation of the number of brightness qualities, see Prof. König's paper, *Ebbinghaus' Zeitschrift*, vol. viii. pp. 377 ff.)

(2) Mr. Johnson further objects to my analysis of the process