IMPROVED THERMO-ELECTRIC APPARATUS.

At a meeting of the Physical Society on April 24, several papers were read by Mr. R. H. Ridout, F.C.S., including one on an Improved Thermo-electric Apparatus, of which the following is an abstract:—

Whilst most instruments of research have undergone a process of developments the beautiful instrument of Melloni does not appear to have progressed since the day of its inception. Much annoyance arises from the pile and galvanometer being separate, and it is a very common occurrence for a pile to be used with any galvanometer that comes first. In reality they are parts of one instrument, and should therefore be fixed to the same base-board. Treating them as parts of one whole, many defects are to be found in theory and construction, and also in the mode of using. I have made a critical examination of each part, and embodied the improvements in an instrument which, with the assistance of Mr. Browning, combines great delicacy and simplicity.

The defects in the theory of the pile are, that the essential or internal resistance must always be much less than the external resistance, and from the low tension of the current, the disparity cannot be wiped out by using a great length in the galvanometer. In practice the faults are,—(*a*), the junctions are too deep, and cause short circuiting; (*b*), the bars are too long and give unnecessary resistance; (*c*), they are too numerous; (*d*), the junctions are too slender; (*e*), the mass of matter to be heated is too great. These are remedied (*e*, *a*, and *d*) by placing the bars in glass tubes, connecting with them plates of copper; (*b*), bars made half usual length; (*c*), a single pair only is used.

The defects of the galvanometer are:—(*a*), the space nearest the needles is not utilized by the wire; (*b*), the needles are not of the best shape; (*c*), the suspension is troublesome. The remedies are:—(*a*), the wire is made into flat ribbon, and wound in one bobbin, and the needles mounted so as to permit this; (*b*), the needles are flat oblong plates, taken from the same piece of steel, and magnatized in one piece; an agate cup and pivot remedy (*c*).

In manipulation the faults are: (*a*), the several parts are not mutually adapted; (*b*), junctions by different metals are exposed; (*c*), the pile and galvanometer are connected first, when, in reality, they should not be connected till the pile has been exposed, or else the current generated abstracts the heat from the hot side, and lowers its temperature.

In the complete instrument, as made by Mr. Browning, the pile consists of a pair of elements ½in. long, the copper connections being circular plates 1-100in. thick, and ⅝in. diameter. The pile is supported by its thick copper terminals above the galvanometer, which consists of a flat copper ribbon, making about 20 turns round a pair of astatic needles, 1in. long, and ⅛in. broad, supported on an aluminium frame, and resting on a fine pivot by an agate cube. A contact key is placed at one side, and makes the only connection in the middle of the instrument. The whole is inclosed in a glass shade, having a perforation at the height of the face of the pile. A glass cone protects the front face from the extraneous heat, and a glass cap the back one. A directing magnet placed above the pile enables the readings to be taken in any position.

The source of heat being placed in front of the pile, the shade is turned round till the hole is in the axis of the pile, and left exposed for say 30 seconds. Contact is then made, when the deflection of the needle indicates the strength of the current very nearly. A very distinct deflection may be obtained from a person standing 6ft. from pile, and a common candle affects it at 3ft. Further, it shows that the walls of a room are of different temperatures, and in any clear weather radiation into stellar space is very evident. The whole thing can be put ready for experiment in half a minute, while, with other forms, the necessary adjustment usually takes more time than the experiments. The same form of galvanometer is also supplied separately.

ERRORS OF REFRACTION IN THE EYES OF MICROSCOPISTS.

BY JOHN C. MORGAN, M. D.

It will, I think, be at once admitted that the requirements in construction and adjustment of glasses, and the results of work done, must vary greatly with individualities of the workers' eyes.

One of the most important, but least thought of, is *astigmatism*,* a condition known to oculists as a common cause of occipito-cervical headaches, sometimes so severe as to be considered due to grave hyperæmia of the brain, or to "brain-fag," etc.

This defect consists in a diversity of curvature; hence, of refraction of one meridian of the cornea, as, for instance, the vertical, with another meridian (horizontal). One of these meridians may be "far-sighted," the other "near-sighted," or the difference may be more moderate.

Some slight degree of this is quite common, as many of your readers will discover on viewing a black line at a convenient distance in these and other positions. In one it will look black and sharp; in another, at a right angle, pale, ill defined, and as if the rays were cut off by a longitudinal slit in a diaphragm. Such a slit, turned in various positions, has a curious effect, illustrating the influence of loss of the rays. Astigmatism similarly affects vision; only, in this, dispersion is the immediate cause of loss.

Another and very simple test of astigmatism is "the point of light"—e. g., a gas flame, reduced to its smallest dimensions (of the yellow), when, to a normal eye, across a large room, it appears as a round point; but not so to astigmatic or to other abnormal eyes. Dispersion of rays results from imperfect focussing; and the object seems larger in consequence (but less bright). If this dispersion be only in one meridian of the eye (astigmatism), the apparent enlargement will be in *exactly the same position*, and the image will be long, not round, and thus the individual may note the precise angle in which a cylindroid lens must be worn, for "correction," and the restoration of the round image. If this meridian be short-sighted, the cylindroid must be concave; if far-sighted, convex.

The experiment may be varied by using a dark card, with a ⅛ inch round hole in it; when placed before a window, strongly illuminated, the point of light appears, of course, and it is more accurate in shape than the flame.

One point more. Spasm of the focussing apparatus (called "spasm of accomodation") may derange the sphericity of the eye, and so affect vision. *Strained* vision is liable to this. On the other hand, the same apparatus may be paralyzed, and *ordinary* vision deficient, whilst the focussing of the microscope entirely *corrects* it.

A linear marking, long or short, on a diatom, or a scale, or a cell, must suffer the same variation in divers positions after the passage of the rays through the best glasses. Some of the disputes as to these may be traced, doubtless, to this cause; and probably may be set at rest by the use of *astigmatic spectacles* with the microscope.

These are merely lenses of prescribed cylindrical curvature, whose axis is placed in the position of the abnormal corneal meridian, whereby its curvature is corrected. The general effect is to render the whole cornea practically spherical in form.

Astigmatism has been an injury to painters, as Turner, whose later pictures (the power of accommodation, or self-correction, being lost with age) are discovered to be distorted in consequence; the tendency being to exaggerate the size of the paler dimension in painting it.

On the contrary, in microscopic drawing, as with the camera lucida, the improperly pale line will be perpetuated, and the perspective misrepresented; and distortion of dimensions generally may be perpetrated by the most careful observers, and endless disputes may thus arise.—*American Journal of Microscopy.*

* From the Greek, *a*, *privative*, and stigma, *a point*—want of focal point.