A BIFILAR PENDULUM.

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This instrument is for measuring movements of the earth's surface, and has been designed by Mr. Horace Darwin; it is a modification of Lord Kelvin's instrument used by Messrs. G. H. & H. Darwin, and described in the British Association Report 1881, pp. 93-126; 1882, pp. 95-119. For the description of the modified instrument see Brit. Ass. Report, 1893.

The diagram, fig. 1 and 2, explains the principle. A circular mirror M, about 20 mm. in diameter, is supported by an extremely fine silver wire, W. The ends of this wire are fixed to two points in the instrument PP', one very nearly vertically over the other: two small hooks on the frame holding the mirror hang to the loop thus formed. The fine silver wire will lie in a vertical plane passing through P and P'; it is clear that if the point P in Fig. 1 moves to one side, the mirror will turn about a vertical axis; also that if the point P is very nearly directly over P' a very small sideways movement will give a large angular movement of the mirror. As the points PP' are attached to the instrument and the instrument itself stands on a firm foundation, an angular movement of the ground about a definite horizontal line will cause the point P' Fig. 1. to move sideways relatively to P, and the mirror to turn about a vertical axis; a tilt about a horizontal line at right angles to this will have the effect of altering the sensitiveness of the instrument; that is, the amount of angular movement of the mirror, for 1″ tilt of the ground will be altered. These alterations of sensitiveness are not of serious consequence as they are small, and it is easy to measure the sensitiveness at any time. The reflection of an illuminated translucent disc in the mirror is observed by a fixed telescope; the stand supporting the lamp and disc is moved along a scale and the position read, when a wire in front of the illuminated disc agrees with the cross wire in the telescope; the change of readings of the scale will give the tilt of the earth's surface measured in one direction only. To obtain a complete record two instruments must be used which record angular movements at right angles to each other. A continuous record can be taken on a moving piece of photographic paper, and the value of the instrument greatly increased.

The ends of the fine silver wire are fixed each to a small pulley; the weight of the mirror is not sufficient to turn them, as their axles are gripped with some pressure, turning both these pulleys gives a convenient vertical adjustment to the mirror for bringing it opposite the window through which it is seem. The upper pulley can be turned when the instrument is mounted; this can be most easily done by means of a screw-driver pressed against the milled edge of the pulley. By moving this pulley the mirror is brought into a vertical plane.

A brass frame carries these pulleys which can be easily removed from the body of the instrument, and the delicate operation of manipulating, the fine silver wire made possible. The bottom of the frame rests in a hollow cone formed inside the instrument just above the window; the top of the frame is pressed by a spring against the point of a fine threaded screw, and can move only in a straight line in the direction of the screw. The screw is turned through a small angle by means of two small bellows acting at the bottom of the lever by means of a rocking arm (see Fig. 3). Two fine tubes lead to a distance and have two indiarubber balls at their ends; thus squeezing one ball forces the air into one bellows and the lever is moved one way; by squeezing the other it is brought back into its original position. Adjustable screw stops are arranged at the bottom of the lever, which allow the lever to only move the definite amount to make the frame rock through an angle of 1″. By this means the amount of the movement of the spot of light on the photo-graghic paper for one movement of the instrument can be at once found.

The body of the instrument consists of a copper tube fixed into a heavy gun-metal casting containing a small chamber very little larger than the mirror and covered in front by a glass window. The instrument is filled with paraffin oil; the mirror thus comes to rest with extreme slowness, and rapid vibrations do not affect it.

The instrument stands on three screw feet, which are turned by two tangent screws fixed to two long rods. The ends of the rods are shown in Fig. 3. The tangent screws are arranged so that turning one will move the spot of light sideways; thus when the spot of light has nearly left the photographic paper it is easily brought back to the required position without approaching the instrument. Moving the other tangent screw tilts the instrument in a direction at right angles and alters the sensitiveness.

The instrument is covered by a case, and should be placed if possible in a cellar, the temperature of which only varies slightly. Great care must be taken with the foundations.

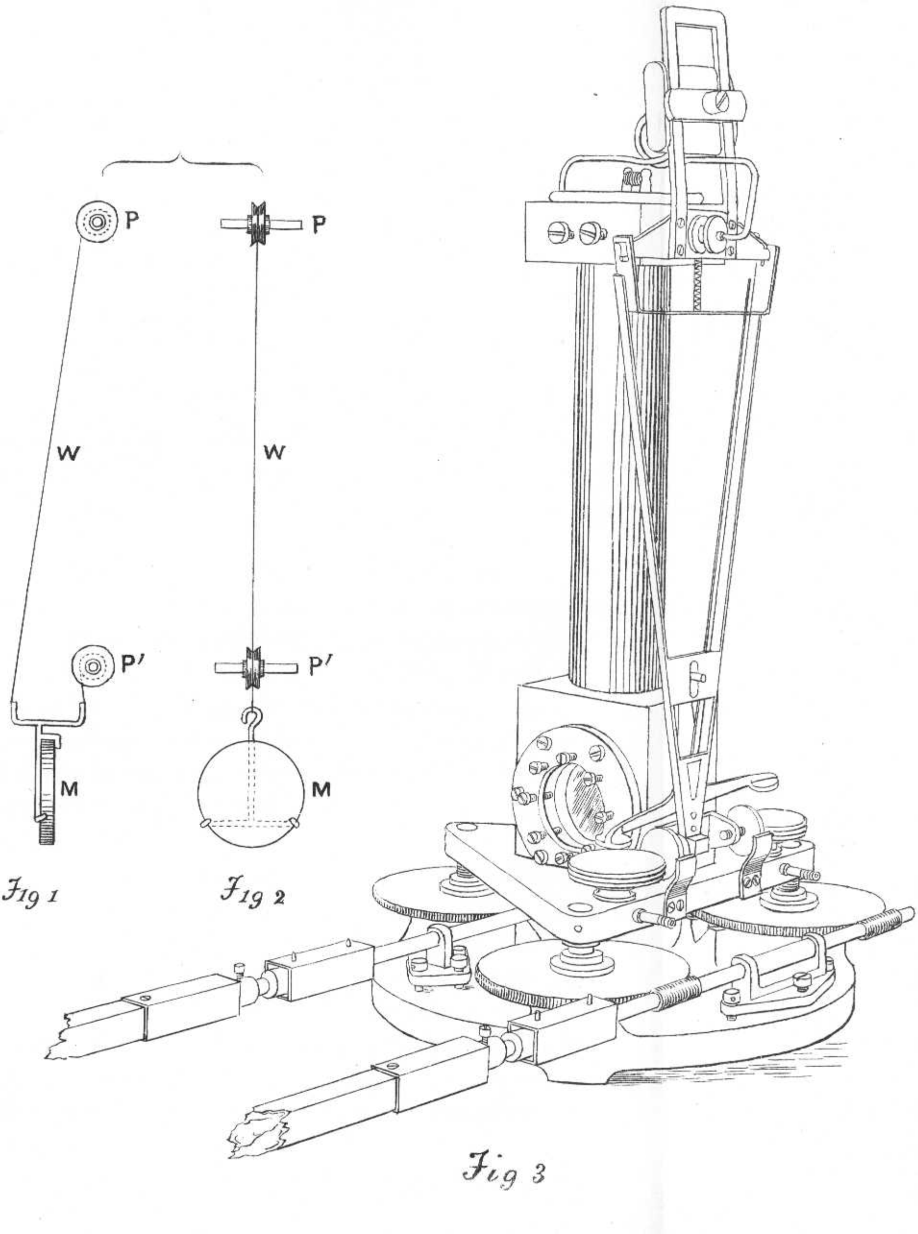

Fig 1

Fig 2

Fig 3