

INSTRUCTIONS FOR SETTING UP AND USING THE GRAY-MILNE SEISMOGRAPH.

(SUPPLEMENTARY TO THE PREVIOUS DESCRIPTION.)

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The instrument should be mounted with its sole-plate level on a substantial foundation, such as a stone pillar built up from the rock if it is near the surface or deep into the ground, if the foundation is soft. In the latter case a heavy log of wood sunk deep, with its length vertical, and firmly packed will do. The foundation pillar should not be high and should be so rigid that its own free vibrations have a very short period. It will generally be found convenient to pass the driving cord of the clockwork under pulleys fixed to the foundation and then over pulleys hung from or fixed to, the ceiling of the room in which the instrument is placed. A good arrangement is to place the weights at the side walls of the room leading cords to them by means of pulleys.

PAPER.—The paper drums should now be mounted as shown in the description and the top screw of the drum carrying the paper made just light enough to keep the paper stretched. A weight of about 10lbs. should be hung on the cord which keeps the paper taut and (when driving on a double cord) about 28lbs. on the driving train. A specimen of paper suitable for the purpose is sent out with the seismograph. If a heavier paper is used the length will be correspondingly diminished. The surface of the paper should not be very smooth, as very smooth paper retards the motion of the siphon by capillary action on the ink. Ordinary thin printer's unalaid paper suits well for the purpose.

GOVERNORS AND SPEED.—The governors should be adjusted to give the required speed. It is not advisable to reduce the slow speed below one third of an inch per minute, because if the speed be too low, the time of occurrence of any disturbance cannot be obtained with sufficient accuracy and the inking of siphons is apt to be too rapid. The governor is altered by screwing the balls nearer to or further from the side of the cylindrical box by turning the central nuts which turn a right and left handed screw and move both balls at once.

PENDULUMS, VERTICAL MOTION.—The pendulums are to be placed in the position shown in the illustration. The lever of the vertical motion one is brought to the horizontal position by adjusting the weight to the proper position on the lever. This can be readily done by slackening the clamp screw at the end of the weight then sliding the weight into position and fixing it by tightening the screw. The link of the compensating spiral spring should reach (when the spring is unstretched) a little above the knife edge. After adjusting it to this position by the screw at the bottom of the spring, they should be hooked on as shown. The point of the lever which remains steady during a sudden vertical movement of the earth is almost exactly the centre of the weight. The magnification is adjusted by changing the position where the link is attached to the siphon lever.

HORIZONTAL MOTION.—The horizontal struts should be placed in position with the knife edge resting against the bottom of the *V*, and the wire then hooked on to the weight. The weight has then to be raised or lowered until the knife edge bears along its whole length. This can be readily tested by feeling if the strut rocks over a point. The position of the strut, the period of oscillation, and the magnification of the record may then be adjusted in the manner described in the paper. The numbers stamped on the side of the strut indicate the ratio of the motion of the steel cone to the motion of the earth when the side of the weight nearest the knife edge is at

the mark. The graduations on the vertical arms of the siphon levers indicate the position of the top of the sliding clamp for magnifications 2, 3, 4, 5, and 10, the weight being supposed at the graduation marked 1 on the strut.

SIPHONS.—The siphons are made of thin glass tube, a supply of which should be sent with the instrument, but which can be easily made by heating a piece of $\frac{1}{4}$ inch or $\frac{3}{8}$ inch soft glass tubing (ordinary German glass tubing does well) in a blow-pipe flame and drawing it quickly out to the proper thickness. The siphons may be bent to the proper shape by means of the burning point of a carbon crayon, but it is, after a little practice, more easily done by means of a minute *horizontal* gas flame. The part to be bent is held close to the flame and the tube simply allowed to bend in the proper direction by its own weight. The ends are then cut to the proper length by holding the tube against a soft pad such as the point of the thumb, and drawing the edge of a sharp hard knife across it and then breaking it at the scratch. The end which touches the paper should be flat and smooth. It may most easily be smoothed by holding it in the small flame until it is red hot. When the siphon is too thick, and in consequence inks too quickly, it should be narrowed by heating it sufficiently at the point to allow it to become slightly narrowed. Care should be taken that the siphon is not so fine that it is unable to supply ink for the high speed. A siphon which writes a good full line when the paper is moving at about $\frac{1}{4}$ inch to $\frac{1}{2}$ inch per minute will write a fine but perfectly clear line when the paper is moving at 30 inches per minute. The siphons should be fixed to the levers with soft wax such as bees wax which, when fixing the siphon, may be melted by holding a hot wire against the backs of the lever.

CHANGE-SPEED MECHANISM.—This will probably be understood from the illustration and description, but one or two adjustments may be mentioned. There is a stop screw extending from the lever which changes the wheels upwards

which may be screwed up or down. The lower that screw is put, the sooner will the speed change *back* from fast to slow, *and it should be so low that the change takes place early enough to prevent the mechanism which adjusts the ball shooting out of gear at the same time, as this is apt to throw forward the ball again.* The final adjustment of the ball should be made on the slow speed. The delicacy of the starter is adjusted by the screw which presses against the spring at the back of the rocking platform.

INK.—The most convenient ink to use is a solution of aniline; this need not be strong, and it will be found most convenient to make up a stock bottle of such a strength as would suit well for an ordinary writing fluid. Care should be taken that the siphons dip well into the ink wells, but that they do not touch the bottom at any part of the range of motion of the lever.
