

for half an hour, at the end of which time only 13 feet of the 18 feet were regained.

The plans exhibited were intended to illustrate a paper, on the deep wells of the metropolis, which Mr. John Braithwaite, M. Inst. C. E., promised to contribute at an early period.

The DEAN of WESTMINSTER, in the discussion which ensued, treated, with his usual clearness of scientific research, the difficult problem of the origin of subterraneous lakes, or sheets of water, and the causes of the spontaneous ascent of the water towards the surface of the earth. He described the influence of the alternating impermeable beds of clay, in retaining within the more porous strata the water received at their outcrop; whence became evident the cause of the rising of water in the artesian wells, sunk through the impermeable London clay down to the porous chalk basin, into which the water had filtered through the fissures and veins of flints from the extensive denuded surface of chalk around the London district. After treating this subject at considerable length, the Reverend Dean alluded succinctly to the proposed speculation for supplying the metropolis with water from the river Colne, and described the labours of the Rev. Mr. Clutterbuck, who, in papers read before the Institution of Civil Engineers,\* had demonstrated by a long continued series of measurements of the water in the chalk hills of Hertfordshire, that all the water taken from that neighbourhood would have been abstracted from the supplies of the river Colne, and would have trenched upon the water-rights of the mill-owners. He alluded also to the rain-gauge experiments of Mr. J. Dickenson, who, during many years, had found by arithmetical evidence that the quantity of the summer water in the Colne varied with the quantity of rain which fell in the preceding winter. And he regulated his contracts for paper to be manufactured in the summer and the autumn by the quantity of water shown by his winter rain-gauge. He stated also that these observations had been corroborated by foreign experiments.

He then treated briefly the general subject of artesian wells; the increased temperature of the water in the exact ratio of the depth; the sympathy between the depression of water in the various wells throughout an extensive chalk district, proving the identity of origin of the supplies. As the number of deep wells was, therefore, constantly increasing, the extra pumping upon one of them necessarily affected all within a certain distance around it. Mr. Clutterbuck's observations confirmed this. He had further observed that the sur-

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\* Vide Minutes of Proceedings, 1842, vol. ii. p. 155; and 1843, vol. ii. p. 156.

face of subterranean sheets of water was not horizontal, but inclined at a considerable rate in consequence of the friction of the strata through which the water descended. The Doctor concluded by directing attention to the remarkable contour of the surface of the chalk exhibited in the sections, upon which he proposed, on the occasion of the paper being brought before the meeting, to offer some observations.

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No. 735.—Mr. R. B. Grantham, M. Inst. C. E., presented and described an improved Clinometer.

The Clinometers which are generally used appear to be made upon too small a scale, to admit of correctness in geological researches, and are not applicable to any other purposes. They seldom exceed 4 inches in length, with all the parts proportionably small, and in measuring dips, or inclinations, the results are unsatisfactory, owing to the surface of the strata seldom being sufficiently smooth, to enable the instrument to be placed steadily upon it.

The smallness and compactness of geological Clinometers, for the purpose of rendering them portable, seems to have been more aimed at, than enabling them to give accurate results, or making them more extensively useful.

Mr. Grantham having occasion to employ one of these improved instruments, for measuring the inclinations of slopes and the strata of rocks, caused one to be made, and found it to answer those purposes perfectly. He then thought that it was applicable to several other uses connected with the practice of engineering, namely, the measuring and determining the slopes of cuttings and embankments, of sea-walls or of beaches, or shores, thrown up by the sea, the inclination of the walls of buildings, the testing the progress of any deviation from the perpendicular, caused by the failure of retaining, and other walls, and for mining purposes, and, in some cases, it might be used in fixing machinery.

He did not claim any priority of design in the invention of the instrument; but he endeavoured to extend the sphere of its usefulness, by making it on a larger scale than heretofore, and with one or two additions. The principal improvement consisted in giving a greater length to the arms, and adjusting an arc of greater radius, and it was obvious the same principle might be carried out to any extent.

The arms are 10 inches in length. Upon that which in practice would be used as the lower one, is fixed a small compass to determine