a shrinkage of from 8 to 25 per cent. is of course not to be wondered at, when we consider for a moment the compacting effects of rain, the running away of the material by side rills and streams down the slopes of the dump, and that it is rarely given such breadth of base as not to allow of the material settling down to a greater ratio of base to height than that originally allowed.

But there are cases of refilling of excavated material where not only does the material filled in, and without any ramming down or consolidation, not leave a swelling above the normal level or surface of the ground, as it should to the extent at least of the material displaced by the sewer, drain or conduit of any kind, but where the stuff filled in actually falls short of the quantity required to fill the trench

This apparently paradoxical phenomenon, which the writer has often noticed during his extended practice and experience, and which has often been observed in wonder by non professionals, is due to the fact that the soil is loosened and swollen before it is excavated or cut into by frost and atmospheric agencies, in the same way as may be observed of the fall-ploughed and furrowed surface of a field during the ensuing spring.

Again, the earth is tunnelled into and through in all directions by worms, and honeycombed by foraminifera, so to say, though not of such microscopic dimensions as those we know of geologically; and to proof: the heaps of soil brought to the surface by ants and other agencies of the kind, as if the mounds raised by termites, honeycombed with their myriad nests, should be expected, if demolished and the material thrown back *in situ*, to rise again to the same height or swell to similar dimensions when all the living catacombs have been filled in.

That common earth may swell at first on being loosened and then be subsequently compacted into its original bulk, is due to the fact that the molecules or particles thereof being plastic and compressible, their parts are thus made to interpenetrate each other or to flow, so to say, into the vacant spaces between adjoining particles, just as certain substances may do, as oats and other elongated forms, when shaken, settle down and occupy less space by arranging themselves to fit the one into the space between the others; but the particles of sand being solid and incompressible, and all in contact on all sides with their neighboring fellows, they can no more be shaken or compacted into lesser bulk, except very slightly, so that such substances as spherical shot and peas, being in close contact, cannot be made to fit closer by any vibratory or impacting process.

The foregoing has not been written in any spirit of antagonism to the contractors or any of those connected with the work, nor as espousing either side of the question, but merely rehearses what has been brought out in evidence and here alluded to, and the matter discussed with a view to enlighten the profession and invite argumentation on a technical, important, and very much disputed subject of inquiry.

AT the recent meeting of the National Electric Light Convention, in Cleveland, the committee on data read a very interesting report, and W. R. Gardener, one of its members, related his method of making a test of the Pittsfield station for the purpose of finding the ratio of the different items entering into the cost of developing energy. The items were as follows:—1st. Steam cost, including coal and water only. 2nd. Cost of engine, including wages of fireman, boiler repairs, interest on boiler room investment, fire and boiler insurance and depreciation of boilers, which is estimated at 5 per cent. 3rd. Cost at the switchboard, including wages of engineers, dynamo tenders, mechanic and wiper; repairs to electric plant, interest on steam electric plant and real estate, insurance on entire building and contents, oil and waste. 4th. Cost at lamp or motor, without depreciation, including the above, and general salaries, office expenses, cost of carbons, interest, incidental expenses, incandescent lamps, law expenses, oil and waste, steam and electric repairs, line repairs, taxes, wages, wiring and wiring supplies. 5th. Cost at the lamp or motor, including depreciation on total investment, which is placed at 5 per cent., but including drop in lines from station to lamp or motor. Taking the fifth item as the total cost, Mr. Gardener found the steam cost to be 33.8 per cent. of the whole; the cost at engine 6.8 per cent. more, or 40.6 per cent. of the whole; the cost at switchboard 26.4 per cent. more, or 67 per cent. of the whole; the cost at lamp or motor without depreciation 15.7 per cent. more, or 82.7 per cent. of the whole; cost at the lamp or motor, including depreciation on investment, 17.3 more, or 100 per cent. He called attention to the great importance of the first factor and advised the greatest care in the selection of coal and its economical use.

A MICROMETER ATTACHMENT.

W. T. Thompson, last month, presented before the Canadian Society of Civil Engineers a paper describing a new micrometer attachment for transit instruments. In connection with the transit telescope it affords the means of measuring with great accuracy small vertical angles between the limits of 0.8 and 3. It consists of a metal box firmly attached to the vernier plate of transit in a plane at right angles to the horizonal axis of telescope, and containing a micrometer screw, with divided head and vernier, and two movable nuts, and bears against a vertical clamping bar, being kept in close contact by a spring. The head of the screw is divided into 100 parts, and is read by the vernier to the $\frac{1}{1000}$th part of a revolution, and as each complete revolution moves the nut through $\frac{1}{40}$th of an inch, the $\frac{1}{1000}$th part will move it through the $\frac{1}{40000}$th of an inch, and as the length of the clamping bar from centre of axis to point of contact with nut is $6\frac{1}{2}$ inches, this will move the telescope through an angle of 0.8," which is the smallest that can be measured with this micrometer. The index nut is for recording the number of revolutions made by the screw; it has 20 threads to the inch, and the edge of box is divided into 20 parts to an inch, so that each turn of the screw carries the index nut through one division; therefore, in making any observation, the number of complete revolutions is read off from the scale, and any fractional part from the divided head and vernier. The clamping bar consists of two parts so arranged that the telescope may be moved in altitude either by the micrometer or by the ordinary tangent screw, so that when desired the micrometer may be set at zero or any reading, and the telescope accurately set on any object by the tangent. In measuring distances with this micrometer, the writer has used for a base a light round rod 30 links in length, about 2 inches in diameter at the bottom, tapering to 1 inch at the top, and provided with a universal spirit level to ensure verticality, with three targets, one 5 links from the bottom,