

ON THE
FLEXIBILITY
 OF
ALL MINERAL SUBSTANCES;
 AND THE CAUSE OF
 CREEPS AND SEATS IN OLD COAL MINES.

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COMMUNICATED BY DR. HOLME.

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IT is well known, that a few mineral substances can be easily bent by the hands, and that they have, in consequence, been called flexible minerals. All minerals possessing this property are laminated, and those which have the greatest degree of flexibility, can be separated into the thinnest lamina: thus mica and talc are some of the most flexible bodies, and are very finely laminated.

Only a few minerals are flexible in hand specimens, but many do, and probably all will bend, when acted on in large tabular masses. The bending of strata is very familiar to

coal-miners. When they make greater hollows than usual, the stratum immediately above the coal, gives way in a little time, in consequence of its being either pressed on by the incumbent matter, or, not being able, if only a thin stratum, to support its own weight. In both cases it bends downwards into the hollow, till it either separates at intervals into small layers, or falls all at once to the pavement. A stratum of sand-stone several yards thick, but divided into separate layers, will bend six feet in a hollow space, whose sides are ten by nine yards. This rate of bending, or degree of flexibility, may be reckoned more than that of the sand-stone strata in general, and more than that of the coaly strata; but it is less than that of the slate clay strata. The ratio of the flexibility of all strata however, is modified very much by the existence or want of the seams of upright distinct concretions: for if these seams are numerous, as soon as a stratum is bent a little, it falls to pieces. We have not an opportunity of determining if any strata or rocks but what belong to the coal formation, are flexible on the great scale, but I have seen some varieties of limestone, and primitive slate, which bend considerably, when in the

act of being separated into small parts by wedges and other tools. Now the inference which may be drawn from these premises, is, that all kinds of mineral matter, however hard and brittle they appear to be in hand specimens, will bend, less or more, when formed into large flat pieces.

Very intimately connected with this subject, is the sinking of the strata above old coal works. In the common way of working coals, care is taken to get as much of the coal as is possible, and none is intended to be left, but undertowns, villages, houses, canals, harbours, or rivers. If about two thirds of the coal be taken away, the remainder cannot support the incumbent matter, of course it sinks, squeezes the pillars into small coals, and forces them out sideways, till all the hollows are filled, and the coal ground becomes so firm as to support its burthen. When as much coal is left as will nearly bear up the roof-strata, the sinking takes place slowly, and the coaliers then say, the *creep* has come upon the mine. The weight forces pieces of coal from the pillar corners, and other weak places, and the pillars themselves appear to be forced into the pavement; they are then separated into smaller parts, which are soon crushed into small pie-

ces, and forced out sideways till the hollows are filled with coal, and the matter of the pavement; lastly, it only remains for the pressure to squeeze the loose matter as firmly as it can. Now, by the time that the coal is separated from the weak parts of the pillars, the sinking of the roof-strata has become evident; and it continues till the stratum next above the coal, is only from one half to one third of the original height of the coal from the pavement. During this process, the first stratum above the coal, or if a thick one, the lower part of it, bends downwards till it is rent from that above it; but the coal pillars not being able to support the disengaged layers, it sinks, and leaves the second layer or stratum at liberty to bend; this layer now bends till it leaves the third, and adds to the weight that the coal pillars have to bear. In this way the separation of the strata goes on, while it can be heard in the hollows of the coal works: when for instance, one layer begins to separate, a small part only is detached at once, with a noise that coaliers call a *thud*. The thuds shift their situations at every repetition of sound: sometimes they move alternately, from dip to rise; they often spread in every direction from the weakest part; they

occasionally commence at the middle, and extremities of the excavated ground at the same time, and meet half way ; and they appear to proceed without any order, being heard in every part at the same time. When in full activity, they are heard every minute, sometimes two or three at a time, then a small pause takes place ; very often they go off in irregular succession, but most frequently at irregular intervals. In this manner they may continue for a few days or till one layer is separated, then they will not be heard, or only heard sparingly for a day or two ; they will then recommence, and be as active as ever. These alternations of activity and rest continue for a few weeks, and then the thuds cease or nearly cease for a few weeks ; they will then begin again with greater force than before. I may remark, that the small cessations are in consequence of the bending of every stratum before it separates from that which is incumbent on it, and the larger cessations happen, when the pillars, having been squeezed out to a greater surface, are just capable of bearing the weight then upon them for a certain time ; hence, the falling layers close up the space to the firm strata, and suspend their bending ; but as the pillars very

soon yield a little, room is again made for the then firm strata to bend, and to separate; therefore, the sinking recommences, and continues, with such like interruptions, till the pillars are squeezed out and fill the hollows. The layers after being once separated, cannot be forced again into their original space; hence the sinking has a limit, and if the distance between the coal and the surface be more than that to which the sinking can extend upwards, the surface strata are not acted on. But if the sinking do reach the surface, small hollows appear which slowly expand, walls separate into parts and fall down, and streams of water enter into small upright seats instead of continuing in their usual course. But the sinking acts upon houses in the most extraordinary manner: the windows break without any visible cause; the window stones crack; afterwards the house sides are rent; and, if the creep be strong at the surface, a part of, if not all, the house falls to the ground.

When the coal mine has been excavated very fast, and most of the coal taken away, a rapid sinking of the roof strata is sure to follow soon after. This sinking is called a set or seat by the coaliers, and differs only from

the squeeze in closing up the hollows in a much shorter time. The whole area of the roof strata in a mine will sometimes sink down at once, but in general only parts of it sink at a time. In the last instance, the air is forced out of the part affected, and if it be mixed with inflammable air, as it often is in fiery coalleries, the most fatal accidents happen to the miners then in the pit ; for the mixture is sure to reach some of their candles, and to produce a terrible explosion.



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