LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

Relation of Coal-Dust to Explosions in Mines.

THE suggestion in my former letter on this subject (vol. xxxiv. p. 595) that "keeping the ventilating air-current saturated with aqueous vapour" might prove the most effective way of rendering the dust in coal-mines innocuous, has, I am glad to see, been since shown to be practicable, in a South Wales colliery. Since the above date, I have considerably extended my research, with results that confirm the conviction therein expressed that many of the most disastrous colliery explosions during the last seven years in this northern district have been practically *dust explosions*, and therefore preventable; that the rough method of watering the floors only, or floors and sides, of the mines is delusive, since it leaves the most dangerous dust undisturbed, the upper and flocculent dust; and last, that probably the reasons why dust in dry pits does not explode more frequently are now within grasp. To this latter conclusion, with your permission, I will now briefly address myself. That every firing of a shot that is accompanied by flame in a dry and dusty pit does not produce an explosion is well known; that *sometimes* such firing of a shot does is unhappily also well known. That the local presence of gas, even in small amount, is sometimes the reason of this is universally acknowledged. That the amount and condition of the dust present (even in the practical absence of gas) is at other times the reason is now believed by many. Setting aside the *amount* of dust, which every one will allow must be an essential factor, and also the varying energy which the shot, blown out or not, develops, let us look at the other conditions. The temperature and hygroscopic state of the air-current is one most important factor, and consequently the concomitant temperature and hygroscopic state of the dust traversed by such current. Beyond this, the *degree of fineness* and the *constituents* of the dust will have much to say in the matter. The finer the particles the more readily will they ignite, and the more completely will they place their substance under the influences present. Thus ordinary screen coal-dust will not ignite when a common match is lighted and applied to it, but it will when finely pounded in a mortar. Now the dust resting on the baulks and upper portions generally of the ways will invariably so light and burn when dry, although the constituents vary greatly in different pits and in different seams of the same pit.

What are the ordinary *constituents* of coal-dust? Two, perhaps three, important substances, and others unimportant: important, as being inflammable in varying degrees; unimportant, either from their uninflammability or from their excessively small amount. The three important are mother of coal, or *dant; coal;* and certain coloured bodies, probably *spores*. The unimportant are shale or other stone dust, iron pyrites, lime flakes, and incidentals, as animal and vegetable matters, and the results of the wear and tear of the haulage and winning apparatus, &c. Dismiss these last, as only one needs any attention, the shale; and that special, not general.

Dant lights most readily; the red end of a used match is often sufficient to fire it, and then it burns itself out whether resting on wood or stone. Burned in a retort, it loses little weight, and the fumes it gives off will not ignite. Now, this dant is largely present in upper and flocculent dust, reaching in some specimens even 70 or 80 per cent. Dant clearly therefore is not itself dangerously explosive, yet is admirably fitted to act the part that tinder used to do, when it handed on the spark from the flint and steel to the old-fashioned brimstone match.

Coal forms a considerable part of all upper and flocculent dust, and constitutes the great mass of the bottom dust along intake haulage roads. Coal-dust (got as free from dant as possible) when pounded very fine ignites with some difficulty, burns at first somewhat fiercely and with considerable smoke, but generally goes out leaving a portion of the heap unburned. Placed on an iron plate and burned by heating the plate, it threw off scintillations, its fumes readily took fire, and forty grains of dust were reduced to one grain of ash. In a retort it gave off first much smoke which would not light; soon, however, the smoke lessened, when its fumes lit and burned with a long bright flame. Such coal-dust is manifestly capable of producing an explosion. Under favourable conditions it can produce a considerable amount of ordinary illuminating coal-gas, whose presence would convert the air-current into an explosive mixture. Therefore, adopting the former simile, as the dant is the *tinder*, so this coal is the *sulphur match*, as the shot flame or other initial cause is the *spark* struck from the flint and steel.

Spores.—Nearly all dusts (and I have examined many) have shown under the microscope few or many orange, brown, or reddish flakes, very often triangular in shape and with concoidal fractures. I have not yet examined thin sections of these coals, but the fragments present much the appearance presented by the spores in the well-known spore coals of the Bradford "Better Bed," and Leicestershire "Moira." If these coloured bodies originate in Lycopodian and other microspores or macrospores, they may play an important part, for the resinous nature of the microspores of the *Selaginella selaginoides*, &c., of our northern hills is so well known that they were formerly used in theatres to produce artificial lightning. As my experiments and inquiries in this direction are yet incomplete, I will only suggest that their presence may account for some dusts being so much more dangerous (as the German experiments have conclusively shown) than others, and add the hope that these words may lead others to pursue this inquiry.

ARTHUR WATTS.

Bede College, Durham, May 26.

Science for Artists.

OF the various optical errors in this year's pictures, certainly that in the elegant scene (624) of the Queen's Accession, in the morning small hours of June 20, 1837, is largest and most hopeless. Neither a source of light at 93,000,000 miles, nor one at 93 inches, could cast the bar-shadows. It is impossible to say whether they are meant to be aërial in the dust or mist, or cast on the walls and wainscot. But for either they are equally preternatural, though not by diverging perspectively. If cast on the solids they would, instead of being straight, be crooking in and out over the mouldings. But if they are in aërial mist or dust, the error is in supposing the same eye can see more than one of such shadows at a time. The eye requires to be very nearly in the plane of the shadow seen, so that, of those cast by parallel things, as window-bars, only one could be seen by any single eye, and only as continuing the line of the bar itself. The bar and its mist-shadow could never meet at an angle, as they all do in this picture. Another error (now common) is in there being no more penumbra than if the sun were a star, or a small electric arc-light.

EDWD. L. GARBETT.

Weight, Mass, and Force.

WITH reference to the extract, as to the language employed in which Prof. Greenhill invites my criticism, I have no doubt that to an engineer it would convey perfectly definite and intelligible information, and that one who has mastered the fundamental notions of dynamics as a science would be able to divine its meaning, but Prof. Greenhill would hardly maintain that the language is scientifically accurate, and that, however sufficient as a shorthand for the trained engineer addressing engineers, it is not full of pitfalls for the tyro.

There is no need to object to the statement that "the *weight* is 137,000 pounds," though it is just as easy to say, "the *mass* is 137,000 pounds." But that "the boiler carries 160 pounds of steam," I find, means that the pressure of the steam is 160 pounds (weight) *per square inch*, while "a 96-feet grade" means "a gradient of 96 feet *per mile*." Surely, except as a recognized shorthand for experts, the suppression of the words in italics is unjustifiable and liable to lead into error.

It is more important, however, to observe that (as in a great majority of the cases an engineer has to deal with) the question here discussed is essentially a *statical* one. The motion of the train considered is uniform (30 miles per hour), and the variations in pressure in the cylinders, &c., are avoided by taking the "mean effective pressure," so that there are no *accelerations* to be considered, and only, in fact, a balancing of forces. The question of *mass* therefore, (a purely *kinetic* notion), can hardly arise, and there is no room for confusion between mass and weight.

R. B. HAYWARD.