

DUST EXPLOSIONS.

THE explosion of a mixture of dust and air, supposed by the head of the firm of Messrs. Bibby Brothers to have been the initiating cause of the catastrophe which destroyed and set on fire part of their oil-cake and seed-crushing mills in Liverpool on the night of November 24, is the most probable explanation of that occurrence. It appears that some of the seeds which contain no oil form an exceedingly fine powder when crushed. The hypothesis is that fine powder produced in this manner became disseminated in the air of the chamber, thus forming an inflammable mixture, and was ignited by some means not ascertained, possibly by a stream of sparks due to friction between the grinding rolls, possibly by an open light. Be this as it may, a violent explosion took place, shattering that portion of the mill in which crushing is carried on, and causing the deaths of thirty-one persons, and, more or less, serious injuries to 112 others.

This event recalls the disastrous explosion which destroyed the Tradeston Flour Mills in Glasgow in 1872, and was investigated and reported upon by Profs. Rankine and Macadam. On that occasion Prof. Macadam stated: "When the whole of the conditions required theoretically for the most disastrous explosions are practically realised, the increase of pressure is equal to eight atmospheres, or 120 lbs. per square inch, which must necessarily bring about a violent explosion and wreck any ordinary building."

Another notable explosion of the same kind, which stands unrivalled in the magnitude of the havoc wrought by it, wrecked the Washburn Flour Mills at Minneapolis on May 2, 1878, and set fire to six other mills and a number of buildings in the neighbourhood. Profs. Peckham and Rye, who were commissioned by the coroner's jury to investigate the circumstances in which it took place, made a series of experiments in closed boxes to test the explosibility of a variety of powdered substances, amongst others various flour mixtures and coal dust. The powders were blown into the box with bellows and ignited by an open light. As the result of their experiments the investigators came to the conclusion "that practically all finely divided highly carbonaceous material would explode under the conditions tried."

Explosions in grinding mills are not, perhaps, so infrequent as might be imagined: a dust explosion occurred in an adjoining block in Messrs. Bibby's mill four years ago, when several workmen were injured, and many similar explosions have taken place in flour mills from time to time, causing damage and setting fire to the buildings, but not heard of beyond the immediate locality, and then probably reported merely as fires.

Most mill owners seem to be now alive to the risks they run from this cause, and take the precaution of limiting the dimensions of the spaces in which mixtures of dust and air are necessarily formed, and excluding open flames from them. Besides flour mills, sugar refineries, starch works, and factories for the preparation of madder, lycopodium powder, flour of sulphur, and so on, have all been the scenes of explosions of this kind. Lycopodium powder, which consists of the spores of *L. clavatum*, the stag-horn moss, is amongst the most inflammable of these substances. It burns with a sudden flash of yellow flame and with a hissing noise, probably due to the bursting of the individual spores, when its mixture with air is ignited.

Lastly, the inflammable, and under certain conditions explosive, nature of a mixture of air and coal

dust is now becoming better understood and appreciated, and has recently constituted the subject of articles contributed by the present writer to the pages of NATURE (vol. lxxxvi., pp. 223, 595).

W. GALLOWAY.

THE TEACHING OF MATHEMATICS.¹

THESE two reports on mathematical teaching cover very different ground, and are treated from very different points of view. The report of the London County Council refers particularly to elementary schools, though in many places it deals with general questions of mathematical teaching that apply to schools of all types. The New South Wales report refers entirely to the work of secondary schools. Again, the L.C.C. report is drawn up by a body consisting mainly of teachers in the closest touch with the child, and, throughout their report, they consider the state of development of the child's mind and the wide differences there must be between the children in the future. In marked contrast to this, the N.S.W. report does not seem to be based on an intimate knowledge of the minds of average pupils, but seems to aim only at the production of future mathematicians.

The L.C.C. report opens with a chapter devoted to general questions of mathematical teaching; then follows an excellent chapter on the first steps in arithmetic. The next chapter, "On the coordination of arithmetic with science and other subjects of the curriculum," is the most suggestive chapter in the report; there are many excellent suggestions for changing the arithmetic lesson from a dull grind to a really attractive lesson, instilling into the pupils a truly scientific spirit. The only doubt that arises in our mind is whether the second-rate teacher will keep a proper balance between the illustrations leading up to new ideas and the new ideas themselves—recent experience in geometry shows that a word of warning is necessary. The fourth chapter deals with the logical and computative sides of the subject—some of the examples considered seem to be the diabolical inventions of the examiner or the text-book writer. Finally, we have a summary of the answers to questions sent round to teachers, examiners, and inspectors—some of these are of great interest; the most interesting perhaps is taken in the first chapter; it deals with the "relative capacity of boys and girls for mathematics":—

"Opinions expressed were in favour of a greater general capacity for mathematics, especially as tested by the solution of problems, among boys, and of greater neatness, accuracy, and conscientiousness in carrying out rules and processes, among girls. It was, however, stated that many brilliant exceptions were to be found amongst the girls. The evidence further went to show that the genius is balanced by the dullard more often among groups of boys than among groups of girls."

Altogether, the report is one of the most suggestive contributions that have been made to the literature on mathematical teaching in schools. We commend it most heartily to all teachers in secondary as well as elementary schools.

In the N.S.W. report there is a paragraph near the beginning which lays stress on the importance of co-ordination in teaching the various branches of mathematics, but it is not worked out in detail, and seems to break down in one or two places; e.g. in the second year trigonometry is included under arithmetic, whereas

¹ London County Council. Education Committee. Report of a Conference on the Teaching of Arithmetic in London Elementary Schools. December 1906-December 1908. Pp. 134. (London: P. S. King and Co., 1911.) Price 1s.

Memorandum on the Teaching of Elementary Mathematics. By Prof. H. S. Carslaw. Pp. 31. (Sydney, N.S.W.: Issued by the Department of Public Instruction, n.d.)