of the finest particles of Sahara sand, while others looked for its origin on laterite ground.

The value of the occurrences of falls of dust is of special moment meteorologically, because they afford us a means of obtaining further knowledge of the actual movements of the air currents in the higher reaches of our atmosphere which cannot be gained by any other such direct methods. Much valuable information was obtained of the movement of the air at great heights by the dust that was ejected during the eruption of Krakatoa, and as this volcano is situated near the equator, where the air currents have a great tendency to rise directly away from the earth's surface, the conditions were favourable for the dust reaching an extraordinary elevation.

Nevertheless, whether the falls owe their origin to dust storms in a desert or eruptions of large volcanoes, it is of great importance to meteorological science that they should be, not only accurately observed, but recorded and discussed. Fortunately, the fall in the present instance occurred where a great amount of useful data could be, and was, secured. In the handling of this material the authors are to be congratulated, for besides considerably increasing our knowledge of the way in which the dust is transported and enlightening us on other peculiarities of this interesting phenomenon, they have given us a volume which will serve as an excellent example for future recorders and observers. W. J. S. L.

BRITISH VERSUS AMERICAN LOCOMOTIVES.

A NOTEWORTHY Parlimentary paper has recently been issued containing correspondence respecting the comparative merits of British, Belgian and American built locomotives running on the Egyptian railways. The paper is full of interest to the locomotive engineer, bearing out as it does the unsatisfactory results obtained with American locomotives on British, Colonial and Indian railways when compared with the English design of engine, and, what is more, these unsatisfactory results are in all cases certified by the representative of the American firm of locomotive builders, as well as by an official appointed by the Egyptian railway authority, so there can be little doubt as to their accuracy.

Probably the most interesting report in the series is that by Mr. Trevithick, the locomotive engineer, who says:—

"The Mechanical Department of the Egyptian State Railways has recently made some interesting comparative trials between British and American locomotives of the same weight and power. These comparisons have been carried out under exceptionally favourable circumstances, inasmuch as the locomotives employed were typical of their respective countries in design and manufacture, and the trials were personally conducted, and the results conjointly signed, by a representative sent out by the American builders and a locomotive inspector of the Egyptian Railway Administration.

"The first set of trials, consisting of eight runs extending over 1034 miles, was between goods engines, and, in order to secure similar loads and to be able to gradually increase the weight of trains to the maximum that the respective engines could satisfactorily draw, the material transported consisted chiefly of coal.

"The total amount of coal consumed in the eight trips by the British engines was 22·84 tons, which works out at an average of 49·4lbs. per mile, whilst the American engines consumed 28·69 tons, an average of 62 lbs. per mile; in other words, for every 100 tons of coal consumed by the British engines the American engines burnt 125·4 tons, *i.e.* an excess of 25·4 per cent. This economy was effected by the British engines, although they drew a heavier average load, to the extent of 14·2 per cent. than the American, the average train taken by the British engines being 57 trucks, or 868 tons, as against 54 trucks, or 760 tons, the average train taken by the American. The maximum load taken by each make of engine was 61 trucks.

"These trials were followed by others between passenger types of engines, extending over 1345 miles; each make ran an equal number of trips with practically similar formation of trains, with the result that the British engines consumed a total of 18·47 tons of coal, or an average of 30·7 lbs. per mile, as against a total of 27·8 tons, or an average of 46·3 lbs. per mile, in the case of the American engines, which means that where the British engine consumed 100 tons, the American engine consumed 150 tons, or 50 per cent. more. Such a difference at 1*l.* 14*s.* 2*d.* per ton, the average price paid last year by the Railway Administration, represents an additional yearly cost per engine of 400*l.*; which is to say that these ten American engines would cost in coal in one year 4000*l.* more than the ten British engines, an amount almost sufficient to buy two new ones."

The above extract from Mr. Trevithick's report conclusively proves that the British type of locomotive is well able to hold its own in the three important matters of fuel and oil consumption, and cost of repairs. Much has been written lately on the standardisation of the locomotive, but in a progressive age this appears to be unnecessary, since the locomotive of yesterday must always be out of date. Much can, however be done to assist locomotive builders in the way of standardisation of specifications and, more particularly, of the test requirements for the material.

It is absurd to think that consulting engineers cannot agree as to the best test requirements for, say, a crank axle or a steel boiler plate. With standard tests the locomotive builders could buy the material more cheaply, obtain quicker deliveries from the makers, and, probably, in their turn take less time to complete an order.

INTERFERENCE OF SOUND.[1]

FOR the purposes of laboratory or lecture experiments it is convenient to use a pitch so high that the sounds are nearly or altogether inaudible. The wave-lengths (1 to 3 cm.) are then tolerably small, and it becomes possible to imitate many interesting optical phenomena. The ear as the percipient is replaced by the high-pressure sensitive flame, introduced for this purpose by Tyndall, with the advantage that the effects are visible to a large audience.

As a source of sound a "bird-call" is usually convenient. A stream of air from a circular hole in a thin plate impinges centrically upon a similar hole in a parallel plate held at a little distance. Bird-calls are very easily made. The first plate, of 1 or 2 cm. in diameter, is cemented, or soldered, to the end of a short supply tube. The second plate may conveniently be made triangular, the turned-down corners being soldered to the first plate. For calls of medium pitch the holes may be made in tin plate. They may be as small as ½ mm. in diameter, and the distance between them as little as 1 mm. In any case the edges of the holes should be sharp and clean. There is no difficulty in obtaining wave-lengths (complete) as low as 1 cm., and with care wave-lengths of 0·6 cm. may be reached, corresponding to about 50,000 vibrations per second. In experimenting upon minimum wave-lengths, the distance between the call and the flame should not exceed 50 cm., and the flame should be adjusted to the verge of flaring ("Theory of Sound," 2nd ed., § 371). As most bird-calls are very dependent upon the precise pressure of the wind, a manometer in immediate connection is practically a necessity. The pressure, originally somewhat in excess, may be controlled by a screw pinch-cock operating on a rubber connecting tube.

In the experiments with conical horns or trumpets, it is important that no sound should issue except through these channels. The horns end in short lengths of brass tubing which fit tightly to a short length of tubing (A) soldered air-tight on the face of the front plate of the bird-call. So far there is no difficulty; but if the space between the plates be boxed in air-tight, the action of the call is interfered with. To meet this objection a tin-plate box is soldered air-tight to A, and is stuffed with cotton-wool kept in position by a *loosely* fitting lid at C. In this way very little sound can escape except through the tube A, and yet the call speaks much as usual. The manometer is connected at the side tube D. The wind is best supplied from a gas-holder.

With the steadily maintained sound of the bird-call there is no difficulty in measuring accurately the wave-lengths by the method of nodes and loops. A glass plate behind the flame, and mounted so as to be capable of sliding backwards and forwards, serves as reflecting wall. At the plate, and at any distance from it measured by an *even* number of quarter wave-lengths, there are nodes, where the flame does not respond. At intermediate distances, equal to *odd* multiples of the quarter wave-length, the effect upon the flame is a maximum. For the present purpose it is best to use nodes, so adjusting the sensitiveness of the flame that it only just recovers its height at the

[1] A Discourse delivered at the Royal Institution on Friday, January 17, by the Right Hon. Lord Rayleigh, F.R.S.