rigidly as possible along its base and at its ends, and if the plan of the upper edge is originally straight there must be some horizontal displacement at the centre of the length from the line joining the abutments, quite apart from such displacement as may be due to the overturning effect of the pressure on a vertical slab. The dam resembles *in some measure* a built-in beam, and, recognising this fact, some large dams have been built slightly convex on the water face.

If a balcony consisting of a plate of variable depth is rigidly supported at its ends and along one side, I imagine that the vertical displacement caused by a load at the centre and front of the free edge of the balcony could not be estimated without some regard for its end and side supports, nor could the stresses due to it be easily determined. There *would* be *some* stress along the horizontal fibres joining its ends, and the elevation of the front edge of the balcony must show contraflexure, since its ends are horizontal and the centre portion is concave upwards.

Can we deny the existence of such effects, whatever their magnitude may be, if a masonry dam is regarded as an elastic body? An engineer should be conscious of all the forces at work on a structure which he is designing, and if these forces and their effects can be correctly estimated, a design may be prepared having due regard to the physical properties of the materials employed and their liability to variation, owing to natural causes and errors of workmanship.

When the forces and their effects are in any measure uncertain, the exercise of due caution, accompanied by mature judgment based on experience, will usually lead to a successful design. It does not seem probable that a mathematical solution can be obtained for the stresses in a homogeneous isotropic dam, rigidly fixed at its ends and base, which can take account of the conditions existing in practice. The solution of the theoretical case would be of interest, but it is questionable to what extent it would be applicable to practical conditions, in which dams are not homogeneous and isotropic, and foundations and abutments are not absolutely rigid.

Engineers recognising these facts have used a simple but approximate method of estimating the stresses in a dam, based on the flexure of beams. The solution based on the theory of elasticity, as presented by Prof. Pearson, may be nearer the truth, but it may be questioned whether this can be known to be the case in an actual dam.

E. BROWN.

Echelon Spectroscope.

FURTHER observations on the secondary bands referred to in my letter in NATURE of January 2 (p. 198) seem to indicate that they are faint spectra of a much higher order than the primary spectra.

Faint spectra of a very high order must be formed by a series of beams that have suffered two reflections at the external surfaces of the echelon. Each of these secondary beams has traversed the echelon three times, and the retardations of the beams form a series the common difference of which is seven times that for the series of beams giving the primary spectra, taking the index of refraction to be 1·5. These secondary beams would only have about one six-hundredth of the intensity of the primary beams, and I thought that the resulting spectra would be too faint to be observed until I found that the reflections that take place at the interfaces of the echelon assist in forming the same secondary spectra.

Assume that each interface reflects the same very small proportion of the light incident upon it, and neglect beams that have been reflected more than twice. Imagine the echelon being built up one plate at a time, commencing with the largest. Each plate that is put on starts a series of secondary beams and adds another term to each of the series started by the earlier plates. The retardations in each of these series have the same seven-fold common difference as the first series, and so they all help in forming the secondary spectra.

Each member of the series started by the nth plate has n times the intensity of the unit secondary beam produced from the primary beam by two interface reflections, consequently the last few steps of the echelon are much more effective in producing the secondary spectra than the steps formed by the first few plates, and the clearness of the secondary spectra given by the echelon may be much improved by covering over, say, the first half of the whole number of steps built up.

In this way better photographs of the secondary bands have been obtained, and I hope to be able to test this explanation of their formation quantitatively.

H. STANSFIELD.

The University, Manchester, January 6.

The Photoelectric Property of Selenium.

I HAVE to thank Mr. R. J. Moss (January 2, p. 198) for the true explanation of the extraordinary increase of conductivity of a selenium bridge enclosed in an exhausted tube. The air pump employed, in the first instance, to produce the exhaustions was the mercury pump of Töpler, and it occurred to me that the mercury vapour might be objectionable. The enormous magnitude of the effect, however, induced me to ignore this vapour. The drop in resistance was finally from 61 megohms to 9·7 ohms. After seeing Mr. Moss's letter I made another bridge, enclosed it in a glass tube, and exhausted this tube with a Fleuss. The result was now an *increase* of resistance in the bridge from 57 megohms to 110 megohms—an increase which can be easily explained. Whether or not the exhaustion produces increased sensitiveness to light and other benefits I cannot yet say. Dr. Shelford Bidwell's conjecture that there was a short circuit in the bridge is the first explanation that naturally occurs, but from the nature of the bridge no short circuit is possible. The metallic parts are absolutely fixed, and separated by thicknesses of glass or mica sometimes amounting to 1 mm.

The result proves the undesirability of exhausting by mercury pumps in certain cases.

Oxford, January 5. GEORGE M. MINCHIN.

Musical Sands.

IN NATURE of December 26, 1907 (p. 188), Mr. S. Skinner's recent exhibition of "singing" sand at the Physical Society is referred to. These particular sands were said to consist chiefly of angular grains. In all my investigations, which have extended over a period of many years, I have never been able to produce musical notes from any sands composed of purely angular grains; indeed, as I have frequently stated, a certain proportion of angular grains mixed with a musical sand will effectually silence it! I dealt fully with this point in my paper on musical sand published in 1888. Again, I have never yet met with purely angular grains possessing smooth and rounded surfaces—conditions which, with others, are essential in the production of music from sands. Perhaps Mr. Skinner meant subangular grains?

I do not think the explanation of the cause of the phenomenon suggested by Profs. Poynting and Thomson in "Sound" ("Text-book of Physics") meets the case. It is based on the erroneous assumption that the sand-grains are arranged as a number of equal spheres in contact. If this supposition were correct, and the condition an essential one in the production of notes, then my experiments with many sands composed of highly spherical grains (like the "millet seed," for instance) should have yielded notes of the highest quality, instead of being, as they all were, mute under the most favourable conditions.

The late Prof. Tyndall, who took a great interest in my work, and personally confirmed the results of my experiments, agreed with my conclusions, and thought *hardness* of grain an important consideration, believing that the loudest notes might be emitted from ruby and diamond sands—if I could get them! I am under the impression that if the theory proposed by Profs. Poynting and Thomson is tenable, it should be possible to obtain notes from comparatively soft spherical seeds (like fig, &c.), but though I have experimented with many kinds, I have not been successful in this direction. I still think my friction theory the simplest, and as many leading men of science have supported it, and no one has as yet disproved it, why may it not be retained?

CECIL CARUS-WILSON.