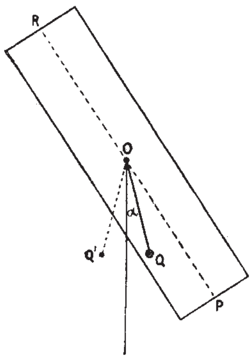
effect that such a device increases the number of degrees of freedom of the apparatus with an accompanying increase in the number of possible oscillations and of conditions necessary for stability is, I believe, incontrovertible. One form of dynamical instability that may result in such cases is the setting up of violent oscillations, ever increasing in amplitude, in the pendulum itself, accompanied by flapping of the control planes, in which case this particular method of control becomes worse than useless.

The remedy which naturally suggests itself, in such circumstances, is to damp down the oscillations of the pendulum by means of frictional or other resistances, and it is probable that few university graduates who have taken first-class honours in mathematics would think that such a contrivance could possibly be wrong. The following test case will show how very dangerous it is to attempt to draw conclusions from general considerations.

For the aëroplane or torpedo, we substitute a heavy, rigid body POR, free to rotate without resistance about a horizontal axis through its centre of gravity O, perpendicular to the plane of the paper, and therefore, in the absence of other causes, in neutral equilibrium, and we assume that the moment of inertia of this body is considerable.

We next imagine a light, small pendulum OQ to be fixed in bearings in the body POR, so that it can turn about the same axis, but we suppose that a frictional couple is called into play between the large body and the pendulum at these bearings. The pendulum being light, this frictional couple exerts no appreciable effect on the large body POR, but the friction is sufficient rapidly to damp out the oscillations of the pendulum itself. The effect of a rudder plane controlled by the pendulum we represent by the assumption that the pendulum operates some mechanism which impresses on the large body a couple proportional to the angle QOP, tending to make it revolve towards OQ, the object of this couple being to bring that body into a position of rest in which OP is pointing vertically downwards.



When the large body is rotating in the counter-clockwise direction (as in the figure) the small pendulum assumes a position of equilibrium OQ on the right-hand side of the vertical, and inclined to the vertical at a certain angle α, the moment of its weight then just balancing the frictional couple. When the body begins to swing backwards the pendulum swings with it until both have described an angle 2α, so that the pendulum occupies the position OQ′, now making an angle α on the opposite side of the vertical. During this portion of the motion the controlling mechanism impresses on the body a constant angular acceleration, because the angle QOP remains constant. Consequently in the new position the body is rotating with a certain angular velocity set up by this acceleration. In the subsequent motion the pendulum remains at rest in the position OQ′, and the body performs a simple harmonic rotation about OQ′, but owing to its initial angular velocity it does not come to rest until its angular distance from OQ′ is greater than the angle QOP. It follows by this reasoning that the oscillations increase in amplitude, and this effect owes its existence to the frictional couple.

G. H. BRYAN.

The Structure of the Diamond.

WE have applied the new methods of investigation involving the use of X-rays to the case of the diamond, and have arrived at a result which seems of considerable interest. The structure is extremely simple. Every carbon atom has four neighbours at equal distances from it, and in directions symmetrically related to each other. The directions are perpendicular to the four cleavage or (111) planes of the diamond; parallel, therefore, to the four lines which join the centre of a given regular tetrahedron to the four corners. The elements of the whole structure are four directions and one length, the latter being, in fact, $1{\cdot}52 \times 10^{-8}$ cm. There is no acute angle in the figure. These facts supply enough information for the construction of a model which is easier to understand than a written description.

If we proceed from any atom, using only standard directions, to the next but one, the straight line joining the first to the last is a diagonal of a face of the cubical element of structure; if we move in the same way through four stages, using all four standard directions in turn, the straight line joining the first and the last is a cube edge. Starting from any atom we can return to it after six stages, using three standard directions twice each. In this way we always link together rings of six carbon atoms.

If the structure is looked at along a cleavage plane it is seen that the atoms are arranged in parallel planes containing equal numbers of atoms, but separated by distances which alternate and are in the ratio 3 : 1 (actually $1{\cdot}52 \times 10^{-8}$ cm. and $0{\cdot}51 \times 10^{-8}$ cm.). It is a consequence of this arrangement that no second order spectrum is reflected by the (111) planes, although spectra of the first, third, fourth, and fifth orders are found. It was this fact that suggested the structure described above. Several other tests, however, may be applied, and all are satisfied.

Zincblende appears to have the same structure, but the (111) planes contain alternately only zinc and only sulphur atoms. In this way the crystal acquires polarity and becomes hemihedral.

W. H. BRAGG.
W. L. BRAGG.

Leeds, July 28.

Artificial Hiss.

REPLYING to the inquiry of Lord Rayleigh (in NATURE of May 29, vol. xci., p. 319) as to the way in which an artificial hiss may be produced with a moderate pressure of air, I suggest that a current of air directed against a sharp edge of a knife held somewhat obliquely may answer his purpose.

In this connection it is interesting to note that for the formation of the hissing sound in our mouth the presence of saliva seems necessary. If I dry the tongue and the other parts which are needed for the pronunciation of the hissing "s," it is almost impossible to produce an audible "s," and the tongue—instinctively, as it were—makes an effort to gather some saliva and to wet itself.

I would therefore suggest that Lord Rayleigh wet the end of the rubber tube with which he experimented.

FRED J. HILLIG.

Kioicho 7, Kojimachi, Tokyo, July 1.

IT had occurred to me also that the moisture of the mouth might play a part in the production of a hiss, but I do not find that such drying as I can give makes an important difference.

I have to thank several correspondents for suggestions. In particular, Mr. G. Beilby sent me two pipes suitable for a 4 in. water pressure, which gave a better effect than anything I had then tried, but still, in my estimation, much short of a well-developed