LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

A Self-reproducing Analogue

THE most striking peculiarity of living organisms is their property of self-reproduction. The most elementary forms, virus or phage particles, can reproduce themselves in favourable circumstances only, and this principle applies also to the multiplication of nucleic acid complexes in chromosomes. It is sometimes thought that the self-reproducing properties of nucleic acid depend upon its highly complex structure. Consequently, any mechanical analogue for self-reproduction would involve very intricate mechanisms. This does not seem to be so, and the device described here has the critical reproductive property although it is of the simplest character.

A flat material, such as plywood or vulcanite, is cut into pieces with shapes corresponding to *A* or *B* drawn to scale in Fig. 1. These objects are placed on a track where they can slide freely though they cannot pass one another. The track, formed by a shelf or groove, is blocked at both ends and restricted by a roof. Horizontal shaking will cause the pieces to move both on account of their own inertia and friction and on account of collisions with one another and with the ends of the track. The pieces will not link up in these circumstances.

Two pieces, *A* and *B*, hooked together, as shown in Fig. 2, are now added to those originally on the track, and shaking is resumed. The result is to reproduce the same *AB* complex at any point on the track where an *A*-piece happens to be immediately on the left of a *B*-piece. If the experiment is repeated, with the alteration that the new pieces inserted are hooked together as *B* and *A* in Fig. 3, the result will be to reproduce this figure, *BA*, at all possible places along the track.

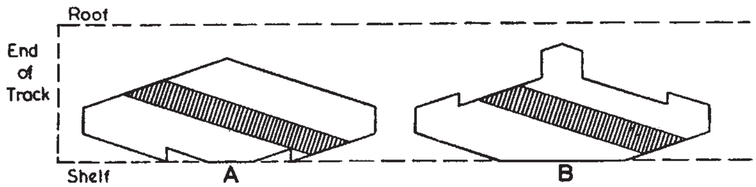

Fig. 1. Elements *A* and *B* in neutral positions on the track

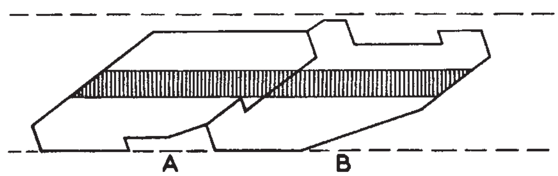

Fig. 2. Elements *A* and *B* hooked together

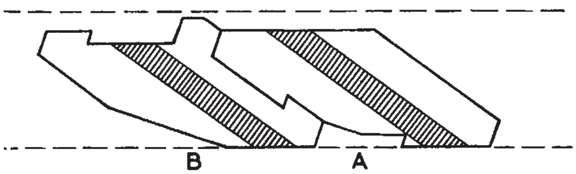

Fig. 3. Alternative complex of *B* and *A*

Table 1

(i) Original neutral arrangement.
A.B.B.A.B.A.A.A.B.A.B.B.

(ii) Result after adding the complex *AB*.
AB... AB.B.AB.A.A.AB.AB.B.

(iii) Result after adding the complex *BA*.
BA... A.B.BA.BA.A.A.BA.B.B.

Thus, if the pieces are arranged as in Table 1, addition of *AB* produces four new *AB* groups and addition of *BA* produces three new *BA* groups. The difference between *AB* and *BA* is analogous to a mutation in that the changed complex is repeated in its changed form. To emphasize the analogy, asymmetrical markings are shown on the surfaces of the pieces. The forms chosen here are not the only ones suitable for this type of demonstration. They need not be symmetrical, though this is useful as it increases stability in the neutral position (Fig. 1).

The example given here shows how reproduction can be demonstrated by an exceedingly simple mechanism. It has been the starting point for construction of more complicated models with similar basic properties.

L. S. PENROSE

University College,
Gower Street,
London, W.C.1.

R. PENROSE

Bedford College,
Regent's Park,
London, N.W.1.

Measurements of Deep Currents in the Western North Atlantic

THE depth of the level of no motion has been a controversial matter among oceanographers for many years. In calculating currents from observed pressure distributions, it has often been assumed that the motion of the deep water must be so slow as to be negligible[1,2]. On the other hand, Defant[3] and Wüst[4] have arrived at consistent pictures of the circulation in the Atlantic using a surface of no motion at intermediate depths. More recently, Stommel[5] has suggested that there should be a deep current along the western boundary of the Atlantic, associated with an internal thermohaline mode of circulation, in the opposite direction to the Gulf Stream.

Some measurements of deep water movements were made during March and early April of this year, using neutrally buoyant floats[6], in an attempt to throw some light on this question of the position of the level of no motion.

In choosing the most suitable part of the Gulf Stream system in which to work, various factors were considered. The surface velocities in the stream off the American continent usually exceed 200 cm./sec., and it was felt that such strong currents would make it difficult to keep track of the deep floats. At Stommel's suggestion, an area off Cape Romain, South Carolina, was chosen. Here the shallow (less than 800 m.) Florida Current flows over the Blake Plateau, while strong pressure gradients are found in the deep water farther offshore. Farther north, towards Cape Hatteras, the violent shallow gradients are superimposed on the deep ones. To the south