Planes is at the eastern nose of the dyke with mineral between its slate roof and the porphyry.

The porphyry, which is near a mineral mass, is fractured and also sheared. The shearing appears as an approximation to a rough irregular cleavage. The fracturing gives a coarse cross pattern and the fractures are now filled with pyrites, chalcopyrite, and gangue. The ensemble of these veinlets is called a stockwork.

The stockwork is always found below or to the side of the mineral, and extends both horizontally and vertically for considerable observable distances from the masses.

I believe that *the masses were fed from depth by the solutions traversing these channel-ways.*

In regard to the shearing and fracturing, it would appear that forces other than those usually termed orogenic, that is, large scale tangential compressive forces, must be called in to explain their origin. The reason is that any forces of sufficient magnitude to shear and fracture the porphyry would have pulverised the slates to a degree not seen in the areas around the dyke. It follows that one should look for the cause within the porphyry mass itself. Where stockwork is strongest there is less shearing and vice versa. Furthermore, the strike and dip of the shearing approximately parallels the contact of the porphyry and slate. These facts seem to indicate (*a*) that the shearing is the result of injectional pressure, and (*b*) that the shattering took place following the crystallisation of the magma when torsional forces were brought into play by slight upward or downward movements of the semi-liquid magma beneath its chilled roof. Where a shear structure existed, the movement was taken up along the already existing lines of weakness, but where the magma had crystallised normally the result was a shattering. The pattern of the shattering on any plane resembles closely that which was produced by Daubree in his classical experiment on the torsional effects on a glass plate ("Etudes synthetiques de Géologie Experimentale." Paris, 1879.)

As the magma cooled, pressures were brought to bear on the interior of the porphyry mass and the mineral bearing solutions were caused to circulate upwards through the fractured zone. *These solutions replaced the softened and comminuted slate,* which had suffered alteration by the intrusion of the porphyry, and to a certain extent the porphyry itself. It may be asked why all the slate at the slate-porphyry contact is not thus altered and therefore in a state favourable for replacement. The answer is that *where the porphyry has cut across the slaty cleavage or where the porphyry has included keel-shaped masses of slate, it has had the opportunity of altering the slates.* Where the porphyry has simply slid up along the slaty cleavage there has been little alteration, because the slate is almost impermeable to solutions in a direction normal to a cleavage plane.

G. Vibert Douglas.
Geological Department,
Rio Tinto Mines, Spain, Sept. 1927.

The Electric Arc in High Vacuum.

Whatever the mechanism of the electric arc, we can scarcely expect an arc to strike and to persist under pressures so low as to render difficult the passage of a high voltage discharge. However, in the course of some experiments on the discharge of electricity through gases, it was observed that under certain conditions an electric arc carrying many amperes can be maintained in a vacuum as high as 0·001 mm.

The electrodes *A*, *B*, and *C* (Fig. 1) are placed under a large bell-jar of 12 litres capacity. Electrode *A* is a heavy rod or block of metal enclosed in *B*, an electrode in the shape of a box made of heavy metal gauze or perforated plate. Electrode *C* is composed of a circular plate and an insulated platinum strip stretched across an opening in the plate; it may be used either as a cold electrode or as a Wehnelt cathode. Electrodes *A* and *B* can be connected to the 230 volt line, and electrode *C* to a source of high potential. When a vacuum is produced under the bell-jar and a high voltage discharge passed between *C* and *B*, an arc strikes between *A* and *B* and keeps going after the auxiliary discharge is stopped. The higher the vacuum, the easier the arc starts. At 0·001 mm. pressure, a p.d. of 60 volts across *A* and *B* is sufficient to start the arc, at 0·05 mm. 120 volts is necessary, while at 1 mm. pressure a p.d. of 230 volts is not sufficient. During the passage of the arc the pressure under the bell-jar naturally increases, but if the electrodes *A*, *B*, and *C* are previously freed from the occluded gases by a prolonged discharge

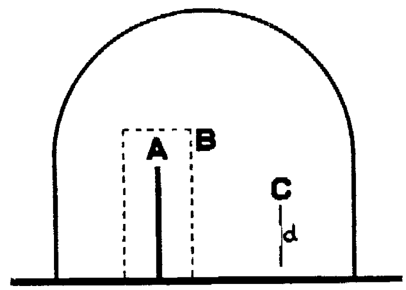

Fig. 1.

and the moisture in the vessel removed by phosphorus pentoxide, this increase becomes very small. In one experiment, for example, an arc carrying 3 amperes for 10 seconds raised the pressure to only 0·002 mm., and at this pressure, after the arc had been interrupted, the high voltage discharge from electrode *C* still passed with difficulty, showing the characteristic green fluorescence on the walls of the bell-jar. The fact that with small potential differences practically unlimited currents can pass between electrodes *A* and *B*, while the low pressure makes it almost impossible for the discharge to pass from the electrode *C* in spite of the high potential applied, is very surprising, and indicates that the mechanism of the electric arc is radically different from that of an ordinary discharge.

The arc has been produced with copper, brass, iron, and aluminium electrodes. It shows the usual current-voltage characteristic, the p.d. across the electrodes dropping to about 20 volts when the current is increased to 30 amperes. When the arc strikes, a brilliant spot appears on the surface of the cathode and continuously changes its position as in the case of a mercury arc.

An interesting feature of the arc is the unilateral relationship which the polarity of the arc must bear to the polarity of the auxiliary discharge between *C* and *B*. If *C* is an anode, the arc strikes independently of the direction of the field between its electrodes *A* and *B*, but when *C* is used as a cathode the arc strikes only when *A* is the anode in the arc circuit. This property of the arc has been successfully employed in some experiments in rectifying alternating current.

S. Ratner.
Physics Laboratories,
Columbia University,
New York, Aug. 30.