doubt, generally the case. But where the warmed water finds a half-opened channel communicating with the upper region, it will experience much less friction on the walls, and must evidently ascend. It might thus be conceived that the ground-water descends by capillarity through the rock-interstices over large areas, in order to mount again through open channels at a few points.

This subject was viewed by A. Daubrée in a much wider significance, and extended to cover the origin of volcanic phenomena. He propounded the inquiry whether the enormous quantities of steam which are daily liberated from the deeper region are continually replaced from the surface, and, if so, how? He pointed out that this water-supply could not take place through open fissures, in which the liquid water descended at one time and the steam ascended at another, but he showed that the descent could be effected through the porosity and capillarity of the rocks. Jamin's experiments have taught us the influence of capillarity upon the conditions of the equilibrium established by means of a porous body introduced between two opposing columns. Daubrée constructed an apparatus in which the temperature in one part of the capillary passage was so high that the liquid must assume the form of steam, and thus escape the operation of the laws governing its infiltration. This apparatus comprised a sandstone slab, with water above and a chamber below, the latter provided with a manometer for measuring the pressure of the steam collected in it. The whole was exposed to a temperature of about 328° F., and steam collected in the chamber of 68cm. mercury column, indicating about 13lb. over the atmospheric pressure in the manometer, or a total pressure of about 1·9 atmosphere. The steam could only come from the water above the sandstone, through which, in spite of the pressure, a capillary filtration took place.

"The difference in pressure on the two sides of the stone not only did not drive the liquid back, but permitted it to filter quickly from the colder side (100° C.=212° F.) to the hotter (160° C.= 320° F.), and favoured the rapid evaporation and the drying of the hot stone surface."

"According to these experiments, therefore, water may be found by capillarity, operating in the same direction as gravity, against a strong interior counter-pressure, to descend from the shallower and cooler regions to deeper and hotter ones, where, by reason of acquired temperature and tension, it is capable of producing great mechanical and chemical effects."

Daubrée's experiment confirms our view that the portion of the ground-water lying below water-level is not stagnant, but descends by capillarity, and, since it cannot be simply consumed in depth, receives there through a higher temperature a tendency to return towards the surface, which tendency is most easily satisfied through open channels. Stated summarily: The ground-water descends in the deep regions also through the capillaries of the rocks; at a certain depth it probably moves laterally towards open conduits, and, reaching these, it ascends through them to the surface.

The solvent power of the water increases with temperature and pressure, and also with the duration of its underground journeying. Hence, while it is descending, it can dissolve or precipitate only the more soluble substances. But the ascending current in the open conduits is undoubtedly loaded more heavily and with less soluble substances, which, as the conditions of their solubility (temperature and pressure) gradually disappear in the ascent, must be deposited in the channels themselves.

The open channels in which the solutions ascend are not the deductions of theoretical speculation. They really exist, as we can prove by induction from appropriate observations.

The Ascending Waters encountered in Mines.—A number of such phenomena are adduced by H. Müller. For instance, in the Gottes Geschick Mine, near Schwarzenbach, in the Erzgebirge, at the depth of 110m. (360ft.), an acid spring containing CO_2 and H_2S emerges from a nickel and cobaltiferous-silver ore-vein. At the Wolkenstein Bad, an acid spring comes from the druses of an ore-vein containing a crust of barytes and amethyst. In the Alte Hoffnung Erbstollen Mine, near Mitweida, bad air and exhalations of carbonic acid led, in 1835, to an analysis of the ground-water, which proved to be weakly acid. In the Churprinz Mine at Freiberg a warm (25° C. = 77° F.) acid spring was struck on the Ludwig Spat vein at the depth of about 525ft. Besides these, Müller names a number of mineral springs occurring in Bohemia and Saxony at the outcrops of mineral veins never opened by mining. In spite of the great reserve which he exhibits, he summarises his view as follows:—

"Mineral veins and mineral springs are certainly adapted to complement each other in genetic theory. On the one hand, the ore-veins, as extended indefinitely-deep fissures, gradually filled, indicate a very profound origin for the mineral springs, and suggest variations caused by time and circumstances in the amount and mutual reactions of their contents, solid or volatile: and, on the other hand, the present relations of mineral springs explain the mode of ingress and deposit of the constituents filling the veins."

Soon after this publication, in 1864, a thermal spring of 73° F. was struck at the depth of 1,774ft. in the Einigkeit shaft, at Joachimsthal, and in the same mine at two other points similar mineral springs, rising with strong pressure, were exposed. They prevented further increase in depth of that part of the mine, and were plugged as far as practicable. The analysis made in 1882 showed that they were acid springs containing considerable silica (33 grammes per ton). In one of them arsenic was also proved to the extent of 22 grammes per ton.

The mineral waters of the Joachimsthal Mines are said to come in contact, near the place where they were encountered, with basalt-like rocks (called *wacken*), which traverse the ore-veins, and are, therefore, of later origin. In general, most of the ore-deposits of the Erzgebirge appear to have a decidedly recent origin, but even from this standpoint the mineral springs found in mining are to be regarded as nothing else than the continuation of those ascending liquids which have filled the ore-veins. Mining depresses the water-level, so that mineral waters circulating in the neighbourhood are forced to those points in the mine where there is only atmospheric pressure.

This "neighbourhood" may, indeed, extend to a comparatively long distance. For instance, the thermal spring at Carlsbad, which is the nearest to Joachimsthal, is 10·5 miles away, and