

mainly that of pressure. Now, at a depth of thirty miles below the earth's surface, rocks would be under an immensely greater pressure than at the surface where they would be rested upon only by the atmosphere; and though at that place a heat of 3,000° might exist, yet that would be insufficient to melt the rock there because of the additional pressure. As the temperature and the pressure increase with the depth, we have no means of ascertaining at what point complete fusion would occur. The earth, however, acts as a substantially solid body. There are doubtlessly reservoirs of molten matter within it, but the crust is most probably thick in comparison.

By the weathering action of air and water, the hard rock would be worn away, as we may see the process now going on. The debris of this action would be carried by the streams downward into lakes and seas; and there it would be deposited as a sediment, in strata, or layers, upon the bottom. Such strata are represented diagrammatically in the view (Fig. 2.)



Fig. 2.

They would probably be uniform and regular when first formed; each deposit by its structure and composition telling much of the conditions under which it was formed. In the minds of many these sets of strata present themselves as separate volumes in the grand history of the globe. The lowest layer has been named the Archaean or earliest formation, and the time which it represents is known as the Archaean Era. The rocks comprised herein are divisible into two classes, the Laurentian, so called from their abundance along the river St. Lawrence; and the Huronian system, named so on account of their occurrence about Lake Huron. The next great division represents the Paleozoic Era, and comprises the Silurian, the Devonian, and the Carboniferous Ages. Then follows the Mesozoic Era, and the Cenozoic or Recent Era.

But these water-formed strata were not allowed to rest undisturbed. Nature appears to have purposely bound these volumes in a more enduring material—consisting of volcanic products such as lava. Volcanoes exist today; these seem to be

vents to the otherwise pent up forces of the earth's interior. The picture shows a section of an active volcano. As examples of volcanic activity, let us consider some cases of modern occurrence; that is to say, such as have happened within the period covered by human records. One of the best known is the eruption of Vesuvius in 79 A. D., by which the three cities Herculaneum, Pompeii and Stabiae were buried from human gaze, and preserved as fossil cities. This eruption was of the explosive type; instead of lava, vast quantities of ashes were emitted, together with immense volumes of steam; and this latter, condensing as rain, formed with the ashes, streams of mud which flowed into the streets, invaded the houses, and covered all as with material for a cast. These cities are now being unearthed, and many startling discoveries are made. In Pompeii, painted signs are found still above the doors; medicines stand on the apothecary's counter, bread has been taken from the baker's oven in which it was probably placed on the day of the disaster. In one house, whitewashing was in progress, the utensils are found, and even the spots of lime can be recognized on the floors. A young pig trussed up for the fire was found upon a dish, where it has lain for more than eighteen centuries awaiting the roasting. The painting and frescoing on the walls, are in many cases as fresh as if applied but a few weeks ago. Surely all such would have been destroyed if molten lava had flowed through the town.

In 1815 a remarkable eruption occurred on the Island of Sumbawa, one of the Moluccan group. It lasted between four and five months. Sounds of the explosions were heard in Sumatra, 970 miles distant; and at Ternate, 720 miles in the opposite direction; a fall of ashes, so heavy that houses were destroyed thereby, occurred at a distance of forty miles, and at a distance of 217 miles in one direction, and 300 miles in another, ashes fell so abundantly as to cause a darkness during the day, equal to that of night.

During the eruption of Cosiguina, in Guatemala, during 1835, ashes fell 800 miles eastward, and 1200 miles to the west.

The force requisite for such volcanic manifestations is almost beyond comprehension. Vesuvius stands 3000 feet high, yet eruptive material has been thrown 4000 feet above its summit. Cotopaxi's top is nearly 19000 feet above sea level, and matter has been projected 6000 feet higher,

and once a stone 109 cubic yards in volume was hurled from its crater to a distance of nine miles. The amount of matter ejected from Vesuvius during an eruption in 1737 was 11,839,168 cubic yards, and in 1794, 22,435,520 cubic yards were disgorged. In 1660 Etna erupted a quantity of lava equal to twenty times the volume of the mountain itself; and the lava thrown from the crater in 1669 covered 84 square miles. According to Dana, 15,400,000,000 cubic feet of molten matter flowed from Kilauea in 1840; this mass would equal a triangular ridge 800 feet high; two miles long and a mile wide at its base. Beside actual eruptions of heated matter, volcanic forces often cause elevations or depressions of extensive regions of country. Such changes of level have occurred in Chili and Patagonia. Raised beaches can be traced 3000 feet above the present sea level. Such disturbances have been noted also in Scandinavia, Greenland, along the shores of the South Atlantic States of our own country, and at the deltas of most great rivers.

In considering these facts and modern instances, we have digressed from the main subject; but such has been done to aid in clear understanding. Now to return—we have seen how the sedimentary strata would be disturbed by volcanic agencies. Many of the layers would become twisted, bent and crumbled, as the leaves of a book under the pressure of some mighty hand. This disarrangement is of great advantage to the investigator, for many of the strata are turned on end, so that their upturned edges are exposed on the surface; thus facilitating observation.

Within these strata we frequently find the remains of animal and vegetable life. Here (Figs. 3 and 4) are two examples taken from Silurian formations.

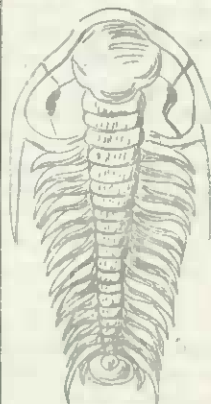


Fig. 3.

The creatures, whose remains are here represented are called *Trilobites*, or three lobed, the structure thus indicated being plainly apparent. The middle lobe contained the viscera of the body, while the extremities were attached to the lateral lobes. *Trilobites* do not live upon the earth to-day.