

are surrounded by an atmosphere rendered luminous by the enormous pressure engendered by their rapid motion (a velocity of twenty miles per second being equal to a pressure of not less than a million and a half of pounds to the square inch), whilst others regard the luminosity as having an electrical origin. The velocity of meteorites is calculated as being from sixteen to thirty-two miles per second. They move faster than the earth rotates, and are often seen to catch up and outstrip the earth. From their high rate of speed, they meet with such resistance when once they enter our atmosphere that they fall with much smaller force than might be anticipated. Meteorites, lastly, are known to have fallen in all climates, during all seasons of the year, and at all hours of day and night. It is calculated that about seven hundred fall upon the earth every year; but this number is probably far below the truth.

Regarded mineralogically, meteorites are divided into *aerolites*, or atmospheric stones *siderites*, or masses of meteoric iron, and *siderolites*, or masses composed partly of iron and partly of earthy matter. Meteorites are found upon reaching the earth to be extremely hot to the touch, and, with one single exception, they have always been found to exhibit a thin vitreous black glaze upon their surface, something like a coat of varnish. It is needless to say that this latter phenomenon is due to the rapid fusion of the exterior of the meteorite caused by the heat developed in its headlong passage through the air. The "siderites," or metallic meteorites, consist mainly of an alloy of native iron with from one to fifteen per cent, of nickel—an alloy wholly different, both chemically and physically, from all known terrestrial products, whether these be natural or artificial. These metallic meteorites are often of very large size, a South American example weighing thirteen tons, and one from Greenland reaching the weight of twenty-two tons. The stony meteorites consist in the main of certain silicates, along with varying proportions of native iron, nickel, and other metals. These also are wholly unlike any minerals which are known to occur in the crust of the earth; although all these elements are themselves present in terrestrial bodies. Nineteen elements in all are known for certain as occurring in meteorites, and all of these occur also in the earth. "One of the most extraordinary points in the chemistry of meteorites is the discovery, by the late Professor Graham, that meteoric iron contains, secluded in its substance, a large amount of hydrogen gas, which may be regarded as a sample of the atmosphere in which it was formed, and consequently as indicating cosmical conditions totally different from those which obtain on our sphere. It is also strange that the metal nickel, which is comparatively rare on earth, and never occurs in the metallic or alloyed state, should be so constant in meteorites of all classes."

As regards the problem of the origin of meteorites, the wildest and most fantastic ideas have, as a matter of course, been entertained in pre-scientific times.

"Towards the end of the former century, La Place sought their origin at a greater distance; he concluded that as gravitation on the moon is some four times smaller than on the earth, it might be possible that the volcanoes there could propel stones with such a force as to go beyond the limits of lunar attraction into the sphere of terrestrial gravitation, as a velocity double or triple that which we can give to a cannon ball would be sufficient to accomplish this result; this hypothesis was accepted for a time, notwithstanding the objection of astronomers and chemists, the former proving that the observed velocity of the bodies and the force with which they strike the earth were much greater than they could possibly obtain from a source so near as the moon; in fact, astronomers proved

that aerolites possess a planetary velocity. Chemists, from their side, pointed out that the chemical composition of aerolites was by no means that of matters ejected from volcanoes, but that they were compounds of metals, as found in earth, but combined in a way different from any terrestrial mineral known; in fact, that the greater number of aerolites were imperfectly mixed alloys of iron and nickel, with 4 to 14 per cent, of phosphorus, the iron being on the average present in the quantity of 60, the nickel of 12 per cent. Chladni, in the beginning of this century, founded his theory in regard to the origin of the aerolites on the opinion of Kepler, who maintained that there were more comets and smaller bodies of different kinds flying about in space than fishes in the ocean. Chladni's theory was that, in the interplanetary and interstellar spaces, small masses of solid matter are moving about in countless numbers, either in regular or irregular orbits, and that when they happen to come within the sphere of gravitating attraction of any planet, they will fall towards the surface with a velocity the resultant of their own planetary velocity *plus* the newly-acquired velocity of gravitation, *minus* the resistance of the air which surrounds the planet. On reaching its surface these velocities are destroyed, and the necessary consequence is the evolution of heat, this being nothing but molecular motion when the latter is forcibly prevented from continuing. This accounts for the heat of the masses when picked up immediately after their fall, while the train of fire exhibited in many instances is easily explained by the consideration that they originally may contain combustible substances which had no chance to burn in the highly-rarefied interplanetary medium; but coming in contact with the oxygen in our more dense atmosphere, and that with the immense planetary velocity, the friction, combined with chemical action, raised the temperature rapidly to the point of combustion."

More than one of the Greek philosophers held that meteorites were truly derived from the sun, and it is curious that the conclusions of modern science appear to point in the same direction. Thus Mr. Mattieu Williams, in his work on the "Fuel of the Sun," considers that meteorites are solar projectiles which have passed the boundaries of the "Zodiacal light—a view which is supported by the fact that hydrogen gas is found secluded in meteoric iron, and has been at the same time shown by recent spectroscopic enquiries to be present in preponderating quantity in the atmosphere of the sun. Mr. Procter also has drawn attention to the tremendous eruptions which are continually taking place in the solar surface, by which gaseous matter is thrown up at an initial velocity of more than five hundred miles per second, to a height of over two hundred thousand miles. This distinguished observer comes, therefore, to the conclusion that if any denser material be ejected from the bowels of the sun by these explosions, it will fly off into space, revolve for some time round some planet, and finally descend upon the surface of the same, as meteorites do upon the earth. If this view be correct, the specimens of meteorites preserved in our museums are actually pieces of the sun.

"If we take in account that the spectroscope shows that the most prominent substance in the sun is iron, and that the same is the case with the meteorites, that they are combined chiefly with nickel, another metal found in the sun, forming an alloy not found on earth: that they also show a peculiar crystallization, and in general a common origin, the view is by no means so improbable, however startling it may be; it is moreover sustained by the unanimous testimony of all modern observers, who affirm that the solar eruptions surpass in immensity any volcanic eruption which ever takes place on earth, or which, in past ages, must have taken place on the moon."