last ray of the sun disappears behind the deep black cover of the moon; a shining wreath of beams, surrounding the totally eclipsed sun to a distance of about one-third of the apparent diameter of the moon, and so bright at its inner edge that we may doubt whether really the sun is obscured and then fading away imperceptibly in the vast space of heaven. The Corona does not always present the same appearance; it is either of a silvery-white or of a reddish tinge, according to the state of our atmosphere, and sometimes colored rays or pencils of light are seen issuing from it. The halo with which the painters surround the heads of saints gives perhaps the best idea of it. It disappears with the first apppearing ray of the sun, as if by magic.

What is the cause of this phenomenon? It must be either in the sun or in the moon. The moon could produce it only if she had an atmosphere capable of refracting the rays of the sun. But since it has been proved that the moon is without an atmosphere, it follows that the cause of the phenomenon must be found in the sun himself.

The following theory was adopted by the best astronomers before the discovery of the spectrum analysis:

If we observe the sun through a good telescope, we see black spots on its surface, irregulary formed and surrounded with a penumbra, that is, an inner ring, which is less dark, and of an ashy-grey color. These spots often combine into a single, larger spot, or separate into different smaller ones, passing over the disc from east to west in periods of nearly two weeks. Sir W. Herschel, and after him most astronomers, believed these spots to be openings in a lumiuous atmosphere of the sun, which alone is the cause of the sunlight, and that the sun, whose body those very openings allow us to see, is dark; that this luminous atmosphere (photosphere) is seperated from the body of the sun by an inner atmosphere, tending to intercept or to soften the heat and light of the photosphere, and that the penumbra is produced by this inner atmosphere.

But there are several important objections against this theory. Thus, it has been observed that the spots, although moving around the surface of the sun, nevertheless retain their shapes often for a long time. But by Sporer's investigation, it has been proved that the surface of the sun is perpetually agitated by the most violent and tremendous storms, moving near the equator in a westerly, in higher latitudes in an easterly direction. But how can the spots, if mere interruptions of a gaseous atmosphere, retain their shape, when this atmosphere itself is driven over many thousands of miles in the most violent convulsion? Again, several astronomers have observed that both the spots and their penumbras are traversed by streaks and veins of sunlight. W. Carrington, in Redhill, saw on the 1st September, 1859, an intense white light, brighter than that on the surface of the sun, suddenly emerging from the centre of a large spot. The phenomenon lasted five minutes, and after its disappearance the spot remained unchanged. The same astronomer inspected some days later the photographic magnetic records in Kew, in respect to declination, inclination, and intensity, and found in each of these the traces of a vast disturbance which had occurred exactly at the time of the phenomenon described above. In 1862 the astronomer Nasmyth stated that he had observed in the penumbra of the solar spots things looking like willow-leaves, which placed themselves over each other, like bridges over bridges. In 1863 other astronomers observed the willow-leaves of Nasmyth, and ventured to assert — especially Sir John Herschel—that they might be living beings developing light and electricity. Even the earth was affected by this phenomenon; for at all observatories magnetic storms were observed, all telegraph wires were overloaded, and an aurora borealis trembled on the sky.

It is evident that the hypothesis which we have stated in regard to the solar spots is unable to explain any of this phenomena. Much less can the appearance of the Corona be explained by it. In order to account for the Corona astronomers have resorted to a new hypothesis, the existence of a *third* atmosphere around the sun—a cloudy sphere. This sphere, they say, is invisible under ordinary circumstances, in consequence of the brighter photosphere; but during a total eclipse it will appear as Corona, either with its own light or by reflecting the rays of the photosphere.

But the Corona is not the only, not even the most remarkable phenomenon of a solar eclipse. For at the moment when the last ray of light has vanished, we suddenly behold on the edge of the dark moon strange conglomerations of a pale reddish lustre, which some observers have compared to glaciers, illuminated by the rising or setting sun, others to reddish mountain peaks, others to immovable flames. These protuberances—so they are called — are not always connected with the edge of the moon or of the sun, but often are separated from it by a considerable distance (up to 2½ minutes). Some, when the moon is about to glide over them, suddenly change their colors, or seem to grow in height, and then new protuberances will make their appearance. These protuberances have especially been seen near those places on the edge, where solar spots had been perceived before the obscuration.

These protuberances were several times observed during the last century, first in 1733 by Bassemius in Gothenburg. But they did not engage the attention which they deserve till Schumacher made his admirable observations in Vienna, ou the 8th of July, 1845; since that time, they have been observed by all astronomers with the most minute care during all total eclipses—in 1850 in Honolulu, 1851 in Sweeden and Prussia, 1858 in Peru and Brazil, 1860 in Spain. It is for the sake of getting photographic likenesses of the protuberances and the Corona that the host of astronomers, who have resorted to the scene of the present eclipse, have provided themselves with photographic instruments, which, by the skill of Warren De la Rue and Secchi, produced surprising results on the occasion of the last eclipse.

Some astronomers think that the protuberances bear the same relation to the outer or cloudly atmosphere of the sun as the terrestrial clouds do to our atmosphere. Others consider them as volcanic masses, formed in or below the photosphere, which have penetrated through the openings that appear as solar spots, and perhaps have caused these openings. Others suppose them to be optical phenomena produced by refraction of light. Some have even considered them as real mountains, which, however, according to their apparent size, would have a height of about 200 miles, if they were on the moon, and of about of 60,000 miles if on the sun.

All these problems have entered a new phase since Bunsen and Kirchhoff, ten years ago, discovered the analysis of the spectrum. We will endeavour to give to the reader a brief outline of this splendid discovery, one of the most important of this century, and especially distined to revolutionize the science of chemistry.

Newton discovered that if a beam of solar light be admitted to a dark room through a small aperture and intercepted by a triangular glass-prism, the rays of the sun will be *dispersed* into an oblong colored figure, which—especially when observed through a telescope —looks like a piece cut from a rainbow, with the known succession of the seven colors, viz: red, orange, yellow, green, blue, indigo, violet. This figure is called the prismatic solar spectrum. The spectra of the planets, but not those of the fixed stars, show exactly the same succession of colors. In the year 1814 Frauenhofer found that the colors of the solar spectrum are not exactly contiguous, but separated by a number of black parallel lines, which are vertical to the length of the spectrum. These lines, whose number is now known to be nearly 2,000 always appear exactly at the same places of the spectrum, however much the angle of the prism may be altered, so that we may consider them as the regular borders of the several groups and shades of colors.

Scientists were in the dark concerning the origin and nature of these lines until recent peculiar discoveries shed an unexpected light on the subject. These discoveries were made by comparing spectra not having their origin in the sunlight. Thus it was found that in the spectrum of chloride of sodium (common salt) the colors appear much darkened, with a very bright *yellow* line at the place were the red color changes into orange. This yellow line is a characteristic proof of the presence of sodium in any body in a state of combustion. *Electric* light does not show any dark lines in the spectrum at all. But if a flame of alcohol, the wick being saturated with sodium, is interposed between the prism and the electric light, a dark line will appear in the place of the bright yellow line. Now, Bunsen and Kirchhoff discovered that the mentioned dark line exactly coincides with one of the lines of Frauenhofer in the solar spectrum, and that the same phenomenon is repeated in innumerable other cases. To each chemical element, treated in this way, corresponds a dark line or a series of dark lines; and if several elements are combined, the corresponding dark lines appear separated without the slightest confusion.

By this discovery an entirely new way of chemical analysis was found. By means of the spectrum may be recognized the presence of the very minutest particles of elements in terrestrial bodies, particles so minute, that by no other method can even a remote approximation to this delicacy be obtained. Thus, the spectrum analysis has disclosed the presence of *one trillionth* of a pound of sodium by means of the characteristic yellow line in the spectrum. We may imagine how enormous will be the result of Bunsen and Kirchhoff's discovery in chemical science. But it is hardly of less importance in astronomy. For the same scholars also made the discovery that there is an essential difference between the spectra of solid and liquid and those of gaseous bodies. Solid or liquid bodies brought to a state of white-heat produce a *continuous* spectrum, in which all the colors are contained without the interposition of dark lines. But gaseous bodies produce bright lines interrupted by dark intervals. Now, when the flame of a gaseous body is interposed between the prism and a white-hot solid or liquid body, the spectrum of the latter at once