be pure or alloyed, each will give his own particular spectrum. In fact, physicists have determined accurately and reproduced by means of tables, not only the spectra of metals, but also those of alkalies and gases. From all these facts they have deduced this fundamental principle of spectrum analysis, that "the spectrum is characteristic of the chemical species."

Careful and persevering experimentation opened the way to discoveries. When all the known substances had been viewed by the spectroscope and recorded accordingly, Bunsen and Kirchhoff were one day surprised at obtaining a spectrum in which were found two blue bands, until then unknown. They had, indeed, come across several spectra in which two blue bands were visible, but in none of them did they occupy the exact positions which they here filled. Having carefully established the identity of these bands, they concluded that there existed a new substance which they termed *caesium*. They had obtained it by the long evaporation of the mineral waters of Germany, whence caesium took its place among the elements with the further distinction of being classed among the metals. Shortly afterwards the appearance of two very bright bands simultaneously with two violet ones of less intensity in their spectroscopic horizon announced a new-comer whom they welcomed under the name of *rubidium*.

These first secrets snatched from nature's jealously guarded treasures, excited the curiosity of both French and English scientists. Professor Crookes discovered a spectrum with a green band, until then unknown. To this embodiment of his toil and perseverance he gave the name of *thallium*. Professor Lamy, a French chemist gave to the sceptical mind a more tangible proof of the efficaciousness of the new analysis by presenting a fact to substantiate the negative proof drawn from the exclusion of known spectra. By long and careful labor he succeeded in isolating thallium, the very metal which Professor Crookes had spied through his spectroscope. A fourth metal distinguished by the indigo band of its spectrum has been recently discovered. It is known by the name of *indium*. In the summer of 1875, Lecoq de Boisbaudran after incredible labor drew from a minute drop of a concentrated solution, a luminous spectrum of two violet lines. The new metal discovered was *gallium*. This quantity of gallium perceptible only to the delicate test of the spectrum analysis, had been extracted from fifty kilograms of zinc blende.

As we have said, the physicist seeks with his spectroscope to pierce the mist in which all gases are diffused in order to identify them, while at the same time he aims at determining the nature of the different metals and alkalies. He again had to adapt his tools to the objects with which he dealt. The gases ever distending their meagre and ill-defined frames through space to elude the chemist's grasp, are well-nigh impregnable. They could not be experimented upon with the same freedom with which solids were. Accordingly they were first cautiously gathered by chemical means, and then held captive within glass walls specially adapted to this end. The glass vessels wherein they were stored, have been styled Geissler's tubes, from the maker's name. The ends of the apparatus which are provided with electrodes are somewhat distended into a cylindrical shape and are joined together by a capillary tube. On the sudden intrusion of the electricity the rarefied gas emits a faint shimmer and thus betrays itself to the physicist.

Plucker and Morren have devoted special attention to the study of the gases. The former made his chief discoveries in 1856. His work is considered by some equal to that of Bunsen and Kirchhoff. He discovered that hydrogen displayed four bands, one orange, one greenish-blue and two indigo. Oxygen was characterized by a yellow, a green and a succession of blue bands. All the gases were thus identified and registered in due order.

The delicacy of the test required the use of the gases in a most rarefied state. It followed from this that mistakes could be easily made in experimenting on gases that were little known, since the spectrum of one might easily be taken as representing another. Mullner further impressed upon physicists the importance of the greatest possible care in the analysis of gases, for he showed that certain changes in the pressure sensibly altered the spectrum. Through the agency of a