

reason at the same time to congratulate himself that he has not like some inventors, lost the credit of his invention, although, like most inventors, he has acquired but little substantial gain from his ingenuity.—*Photographic Journal*.

#### On the Chemical Analysis of the Solar Atmosphere.

Kirchhoff has communicated some further results of his remarkable investigations on the constitution of the solar atmosphere. The author maintains that the sun has an ignited gaseous atmosphere, which encloses a core of still higher temperature. If we could see the spectrum of this atmosphere, we should detect the bright lines which are characteristic of the metals existing in it, and should recognise the metals themselves from these. The more strongly luminous body of the sun does not, however, permit the spectrum of his atmosphere to appear. It inverts this spectrum; so that instead of the bright lines which the spectrum of the atmosphere alone would exhibit, dark ones make their appearance. We see, therefore, only the negative image of the spectrum of the sun's atmosphere.

In order to study the solar spectrum with the requisite degree of accuracy, Kirchhoff procured from the workshop of Steinheil an apparatus consisting essentially of four large flint-glass prisms and two telescopes.

With this apparatus the spectra are seen in a hitherto unattainable degree of distinctness and purity. It exhibits in the solar spectrum thousands of lines, with such clearness that they are easily distinguished from each other. It is the author's intention to draw the whole spectrum, as seen with his apparatus, and he has already done this for the portion which lies between Fraunhofer's lines D and F.

This apparatus exhibits the spectrum of an artificial source of light with the same distinctness as the solar spectrum, provided only that the intensity of the light is sufficient. A common gas-flame, in which a metallic compound evaporates, is usually not sufficiently luminous, but an electric spark gives with the greatest distinctness the spectrum of the metal of which the electrodes consist. A large Ruhmkorff's induction-coil yields electric sparks in such rapid succession that the spectrum can be observed as easily as that of the sun.

A very simple arrangement permits the comparison of the spectra of two sources of light. The rays of one of the sources may pass through the upper half of the vertical slit, while those of another pass through the lower half. When this is the case, one of the two spectra is seen immediately beneath the other, and it is easy to determine whether coincident lines occur in both.

In this manner the author satisfied himself that all the bright lines peculiar to iron correspond to dark lines in the solar spectrum. In the portion of spectrum between D and F, about seventy particularly well-marked lines occur, resulting from the iron in the sun's atmosphere.

Iron is remarkable on account of the great number of distinct lines which it produces in the solar spectrum. Magnesium is interesting because it produces the group of Fraunhofer's lines lying in the green denoted by Fraunhofer by *b*, and consisting of three very strong lines. Very distinct dark lines in the solar spectrum correspond to the bright lines produced by chromium and nickel, and we may,

therefore regard the presence of these substances in the sun's atmosphere as proved. Many other metals appear, however, to be wanting in the sun's atmosphere. Silver, copper, zinc, lead, aluminum, cobalt, and antimony have extremely brilliant lines in the spectra; but no distinct dark lines in the solar spectrum correspond to these.

Many metallic compounds do not give in a gas-flame the spectrum of their metal, because they are not sufficiently volatile. In these cases the spectrum may be made to appear by means of the electric spark. It is true that in this case the spectrum of the metal of which the electrodes consist and that of the air in which the spark passes is also seen. To avoid the difficulty arising from the very great number of bright lines of which the spectrum of every electric spark consists, it is necessary to have recourse to a particular arrangement. The electric spark is allowed to pass at the same time between two similar pairs of electrodes, the light of one spark being allowed to pass through the upper, that of the other through the lower half of the slit, so that one spectrum is seen above the other. When the two pairs of electrodes are clean, the two spectra are perfectly similar; when, however, a metallic compound is placed upon one pair, the corresponding spectrum immediately shows the lines belonging to the metal introduced. The author has satisfied himself that in this manner even the metals of the rare earths, yttrium, erbium, terbium, &c., may be recognised most quickly and certainly. It is, therefore to be expected that, by the help of Ruhmkorff's apparatus, the spectral method of analysis may be extended to the detection of all metals. The researches which the author has undertaken, in connexion with Bunsen, will, it is hoped, determine this point.—*Journ. für Prakt. Chemie*.

#### The United Kingdom, in 1860.

The annual Statistical Abstract for the United Kingdom, prepared by the Board of Trade, and published by the Queen's printers, appears this year in the convenient form of a thin octavo volume. These annual summaries extend from 1841 to the present time, but 1860 is the most remarkable year in the series. We bought and manufactured to an extent unknown before. But then there was a larger population to do it. The population of England and Wales in 1860 was estimated at 20,000,000, and that of Scotland above 3,000,000. The births in the year exceeding the deaths by 298,579, and our prospects are good for the unprecedented number of 381,436 persons married. There are no means of completing this statement by including Ireland, but even if its population should prove to be only 6,000,000 it is probable that the births in the United Kingdom altogether exceeded the deaths by 1,000 a day. Emigration took from our shores 128,469 persons in the year, but a large deduction must be made from this for the immigration of the year, of which, however, there is no record. The number of paupers in receipt of relief cannot be given for any one date; in England it was 890,423 at the close of the year, and in Ireland 50,683; in Scotland, on the 14th of May, 78,306—altogether rather more than 1,000,000, out of our population of 29,000,000 or 30,000,000. We were not a pauperised people, or we should not have raised as we did a net revenue of £67,458,093, the largest sum that ever found its way from the pockets of the taxpayers into the exchequer since the close of the great European war, with the single exception of the year 1858 (the Crimean war.)

Comparing 1860 with seven years ago, we have ad-