In conclusion, it appears to me that the close relationship of the metals aluminium, gallium, indium, iron, and chromium, makes it probable that molecules of both formulæ M_2R_3 and MR_3 may be capable of existence in the case of all these metals, even though the conditions necessary for the stability of the higher molecules have not yet been attained for indium and chromium chlorides. That the conditions have been attained in the case of the chlorides of aluminium, gallium, and iron, appears to me to admit of no doubt.

SYDNEY YOUNG.

University College, Bristol, March 23.

Luminous Night-Clouds.

IN accordance with my anticipations (see *Astr. Nachr.*, 2885), luminous night-clouds have now been seen at the southern point of South America. Herr Stubenrauch, meteorological observer at Punta-Arenas, writes to me that he twice saw the phenomenon in December 1888. According to the same observer, it was noticed several years ago by a naval officer in the Beagle Channel, rather to the south of Punta-Arenas. The description given by Herr Stubenrauch leaves no room for doubt that the phenomenon is identical with that observed in Europe.

Sternwarte, Berlin, March 28.

O. JESSE.

Zodiacal Light Observations.

COULD any of your readers furnish me with a list of observations of zodiacal light, or refer me to any record where such a list can be found? I applied to the Meteorological Office some years ago, and found that no such list was to be obtained. All I require is the precise time of the display, the place of observation, and any other mathematical observations concerning the angle of inclination, &c., which may be relied on.

W. DONISTHORPE.

32 Pembroke Villas, W., March 30.

Vapour, or Meteoritic Particle.

ABOUT 6.30 p.m. on Friday last, while out in the country, I observed a large meteor falling slowly and almost vertically in the north-north-east. After it had disappeared, half-way between the zenith and the horizon, I noticed, in the strong twilight, a faint phosphorescent trail, which did not disappear, but changed to a straw-colour, like a streak of vapour illuminated by the setting sun. Gradually the shaft expanded in the centre and contracted at the ends, until it assumed the shape of a balloon. Continuing to change, it flattened out horizontally like a football, and apparently about half the size; and it looked a little brighter as it became more condensed. This process occupied quite half an hour, and the object remained like a nebulous patch lit up by the sun's rays, until that orb was well below the horizon, finally disappearing about 7.15 p.m. That part of the sky was perfectly clear—there were no clouds except the usual dense bank on the horizon.

F. B.

Rugby, March 27.

The Satellite of Procyon.

WITH reference to Mr. Barr's letter on p. 510, I would mention that Mr. Burnham has lately observed Procyon with the 36-inch refractor at the Lick Observatory, and finds no trace of any close companion with powers up to 3300.

H. SADLER.

RECENT RESEARCHES ON THE RARE EARTHS AS INTERPRETED BY THE SPECTROSCOPE.¹

IF I name the spectroscope as the most important scientific invention of the latter half of this century, I shall not fear to be accused of exaggeration. Photography has rendered vast services in recording astronomical and biological phenomena, and it even supplies us with indirect means of studying ray vibrations to which the human retina does not respond. The electro-acoustic devices of

¹ Abstract of Address delivered on Thursday, March 23, at the annual general meeting of the Chemical Society, by the President, Mr. W. Crookes, F.R.S.

Edison and his co-workers permit almost magical communication between human beings. Ruhmkorff's coil and the Geissler tube have rendered notable service in physical investigations; and the electric lamp promises to aid in exploring the internal parts of living animals as well as in studying the organic forms of the deep sea. But in the spectroscope we possess a power that enables us to peer into the very heart of Nature. In the extent of its grasp and the varied character of its applicability it surpasses the telescope, and at least rivals the microscope. It enables the astronomer to defy immeasurable distance, and to study the physical condition and the chemical composition of the sun and the stars as if they were within touch, and even to ascertain the direction of their movements.

Without attempting to discuss the import of the results thus gained—which would lead us too far—I may point out that they overthrow a dogma concerning the classification of the sciences. It has been said that the simpler and more general sciences lend both doctrines and methods to the more complex and less general sciences, and that the latter give nothing in return. But we now see chemistry endowing astronomy with an original and fruitful method of research.

Turning to the very opposite extremity of the scientific hierarchy, we find that to the biologist the spectroscope is of value in studying the relations of animal and vegetable fluids, and even of certain tissues. But this wonderful instrument is clearly destined to play its chief part in what is called terrestrial chemistry—the field where it has won the most signal triumphs.

It must be remarked, despite this vast range of applicability—a range sweeping through the whole universe and embracing all the four elements of antiquity—and despite the astonishing results already achieved and the prospect of greater revelations to come, that the spectroscope is still inadequately appreciated by professed men of science, and in consequence is to a great extent ignored by the “educated and intelligent public.” In urging its more thorough recognition, I do not advocate the formation of Spectroscopic Societies for the fragmentary study of everything that can be observed with a spectroscope. But I recommend researching chemists to appeal to this instrument wherever requisite and possible.

An elaborate spectroscopic study of the basic constituents of rare minerals from different localities would be of great value, and I would suggest that on all possible occasions meteorites should be submitted to careful spectroscopic analysis.

I do not propose to discuss all the splendid achievements of the spectroscope in chemistry; nor its applications in ordinary analysis, qualitative and quantitative; nor the conduct of technical operations, such as the Bessemer process. I confine myself to the light thrown by the spectroscope upon the nature and the relations of our elements, real or supposed.

Though systematically employed by few experimentalists, the spectroscope has already led to the discovery of several hitherto unknown elements. In the early days of spectrum analysis, attention was mainly concentrated on the flame spectra: that is, the bodies in question were vaporized and rendered luminous by the action of a flame, such as that of the Bunsen burner or of the oxyhydrogen jet. This procedure in the hands of Bunsen and Kirchhoff gave us caesium and rubidium; afterwards, in my own hands, thallium; and in those of Reich and Richter, indium.

Then followed the production and examination of spark spectra. The spark produced by means of the induction coil, especially when its energy is reinforced by the intercalation of a Leyden jar, volatilizes and renders luminous minute portions of matter, solid, liquid, or gaseous, which may then be examined by the spectroscope. In this