sprung, and which gives the most finished style. Looking at the character of the *National Quarterly Review*, and at the progress and circumstances of the times, Mr. Shears may be mainly instrumental in developing in the North and South a new school of writers, of poets, historians, novelists, essaysists, and critics. The war we have just passed through, the wonderful events of the time, and the quickening power of the modern agents of civilization, cannot but develop in this country great mental activity and intellectual culture. We see already the dawn of this state of things. In journalism, as in magazine literature, and in various ways, particularly among the young men, we perceive a growth that may probably place America in the first rank of literary nations. Mr. Sears is in a position to do much in bringing this about. He is, as was said, well qualified. The *National Quarterly Review* may become to this section of the country what the *North American* was to New England and what the *Edinburgh Review* was to the literature of Great Britain.—*New York Herald.*

The Story of the Spectroscope. (1)

The invention of the telescope put into existence new worlds and, at the same time, enlarged the already vast boundaries of human thought. It constituted a mighty and dazzling advance. It opened splendid highways out upon and around the shining borders of the stellar world. It permitted men to gaze upon unheard-of marvels, and pointed to prospects the view of which was almost too splendid to be borne. Human sagacity, it was believed, could go no further; human achievement could do no more.

And yet we have to-day another equally marvellous advance. Notwithstanding the victories gained over the wandering planets, the blazing sun, and the gentle moon—

"Whose orb
Through optic glass the Tuscan artist views"—

it was reserved for the spectroscope to accomplish still greater things, and to give, in reality, a new heaven, if not a new earth. While the telescope brought to men's knowledge the existence of many new globes, showed the forms of suns, and brought almost within apparent reach the huge belted sphere, it could do no more. But the new wonder goes further, and does not leave the child when gazing through some astronomer's glass at the glittering specks, sown like diamond-dust along the sky, to wonder what they are. With this new instrument in his hand, the philosopher smiles at the old difficulties before which he once stood aghast, and reveals with precision the secrets of the nebulous region which he formerly thought must forever remain unknown.

But what is the spectroscope ?

In the language of science, this is an instrument for forming and examining spectra produced by artificial or natural flame, in order to determine, from the position of the spectral lines, the composition of the substance which is in process of combustion; or, in simpler language, it is an instrument to observe the lines which cross the spectra of natural or artificial light. This instrument, in reality, involves an adaptation of the telescope. Yet the light may pass through a tube, either from a candle or a star, and, instead of entering the eye, it passes through a prism, when it may be viewed by a common telescope. In a still simpler way the object may be accomplished.

Let a beam of sunlight pass through a hole in a shutter, go thence through a triangular prism, and on through a bi-convex lens, and fall upon a white screen. Now to the ordinary observer, nothing will be seen on the wall; but look more closely, and there will appear certain dark, parallel lines, which will be developed more strikingly by the aid of a good spy-glass. Here you have the principle of the spectroscope, which has effected within a brief time a marvellous revolution in demonstrative science. How simple is the apparatus and obvious the method!—and yet with instruments operating in this way we attain results which Lord Rosse's telescope struggles for in vain, and are able to declare the nature and condition of those nebulæ which have heretofore baffled the most advanced thought.

Now, therefore, one word more of explanation :

By spectra, of course, are meant the different-colored rays of which the light is composed, and which by the prism are laid upon a white screen. When the light is natural, as from the sun, the spectra will be crossed by a multitude of fine, dark lines; but when the light is artificial, the spectra are crossed by bright lines. And the relative positions of the lines are always fixed, so that the spectrum has been carefully mapped. Every element, when in a state of combustion, is found to produce certain lines in its spectra, so that by examining the spectra we may know for a certainty what substance is burning and producing the light

Here again, therefore, we are led to express our amazement at the results which follow from so simple and beautiful a process, which gives us the long-dreamed-of connection with the sun, and enables us to say with certainty what must be the composition of that vast fiery globe.

It would be interesting to trace the progressive development of the spectroscope, or, perhaps, it might be said, spectrum analysis, did time permit. Beginning in Sir Isaac Newton's discovery of the solar spectrum in 1675, the idea emerged in 1814, in "Frauenhofer's line," afterward to be carried on by Brewster, Herschel, and other eminent men. In 1822, Brewster found strontium and copper in the flame of a common lamp, and observed and found the bright lines of the spectra varying with the color of the flame. In 1834, Mr. Fox Talbot was able to tell lithia from strontium by means of the spectrum; and, in 184[illegible], Professor Miller mapped the spectra of several incandescent metallic vapors. In 1861. Mr. Cook took up the subject with great success, being followed by Roscoe. But it remained for Kircholf to reveal the mystery that had baffled critical minds for half a century. And this fairly led to the inspiring utterance of the old, but now intelligible, cry, "*Sic itur ad astra*"—this way leads to the stars!

And now, to speak more particularly, what are the present results of these investigations? They must be summed up as briefly as possible. Take first this specimen. Says one writer :

"Let us look, for a moment, as if through Mr. Huggin's beautiful spectroscope, at the well-known star Sirius, of whose amazing distance mention has been made. It appears to us a brillant point only, albeit we may not doubt it has sixty times the bulk of our great sun, while yet giving us only the six-thousand millionth part of his light. But this is light enough for the prism's work. The slender beam that has been travelling from the star earthward, with a velocity of more than eleven million miles every minute, glides along the telescopic tube, and then steals through the almost imperceptible slit of the spectroscope, and, if we may be pardoned a play upon a word (which we protest is only fair in treating of so *light* a subject), it *hues* its way through the prism, and writes upon the screen in unmistakable colored symbols, some of them as plain to us as English words, the nature of the fiery home from which it has been an exile, for as long a period as it requires among us to transform a new-born babe into an independent man!"

And again let us quote :

"In May, 1866, a small star in the constellation Northern Crown blazed out for several days with a splendor which almost put the first magnitude stars to the blush. The spectroscope served to reveal to us the scarcely hypothetical explanation of the phenomenon. The tell-tale prism detected bright lines in its spectrum. Our readers know, by this time, what bright lines signify. There was manifestly intense gaseous inflammation upon the star. It blazed to a magnificent splendor, and then gradually died out, while its spectrum lines also dwindled. Was this a grand hydrogen combustion, a star on fire? So the markings indicated. Is there nothing here significant to us, as dwellers upon one of the satellites of a fiery star, which has with its luminous shell a probably concentric stratum of hydrogen, so vast in its extent that it can shoot up, from its furnace-throats, rose-tinted flames that stretch a hundred thousand miles up into its atmosphere?"

But now we must epitomize. First, then, note how the spectroscope has reversed the opinion of astronomers in regard to the state of certain nebulæ which they thought were composed of clusters of stars. Some of these nebulæ give no more light than a single sperm candle at a distance of a quarter of a mile, and yet that feeble ray is sufficient to tell the story. In the spectroscope, these supposed worlds fly, and all that is left is a little gas, which writes the story in certain faint, dark lines! Hail, therefore, noble Laplace! The spectroscope proclaims the much-scoffed nebular hypothesis possibly true. Only forty of the seventy nebulæ examined told of a white-hot nucleus by its "absorption bands."

So, likewise, the spectroscope dissipates the notion of a nucleus in comets.

Then it turns to the earth, and reveals metals which have hitherto been unknown. It goes into practical operation in the manufactory for the production of steel, and tells by the "carbon lines" in the spectra the *exact instant* when the air must be shut off to secure the perfect work.

It leads Bunsen to evaporate forty-four tons of water to detect a new mineral in the Dürkheim Spring. It tells of the decomposition of light. It informs us of the substance of the sun, and declares that Sirius, a star sixty times larger than the sun, is rushing away from the earth at the rate of one hundred and eighty miles a minute.

These are results that astronomy alone could never achieve.

(1) Spectrum Analysis. Six lectures delivered in 1868, before the Society of Apothecaries, in London. By Henry E. Roscoe.