[Reported for the Scientific American.]

THE PROGRESS OF STELLAR CHEMISTRY.

A very able and interesting lecture was delivered, not long ago, before the Liverpool Scientific and Philosophical Society, by Professor E. L. Davies, upon the subject of the progress of stellar chemistry. The writer of the subjoined was present on the occasion, and from notes taken at the time has given us the following:

Though it is only within the last eight or nine years that stellar chemistry has developed itself into what may now be called almost a distinct science, it is necessary, in order to thoroughly understand the discoveries of modern times, to go back, nearly two hundred years, to the time when Sir Isaac Newton first discovered the compound nature of white light. In 1675, Newton first announced this discovery. He allowed a beam of daylight to enter a darkened room through a round hole in the shutter, and interposed, in the course of the light, a prism of glass. The light thus treated he found to have undergone refraction, and moreover that it had not been equally refracted throughout, but that certain of its elementary rays had suffered a greater deviation from their original course than others, and that, as a result, instead of the image of the hole in the shutter being formed on a screen placed behind the prism, there was produced a colored band; and this colored band Newton called the solar spectrum.

This spectrum is found to consist of rays of light of the following colors: red, orange, yellow, green, blue, indigo, violet; of which the red suffered the least refraction (that is, was bent the least from its original course), and the violet, the most, the others being intermediate in the order named. Newton also found that if one of these colored rays, the green, for instance, was separated from the others, and again passed through a prism, that it did not undergo any further any further decomposition, and that it was therefore monochromatic. From these experiments, he concluded that while a daylight beam was composed of rays of different degrees of refrangibility, and also that rays that differ in refrangibility also differ in color.

Little more was done until more than a century after, when Wollaston further investigated the subject; and by admitting the daylight through a fine slit instead of a round hole, he observed that the solar spectrum was crossed by a number of fine black lines; and in 1814, Frauenhofer, an optician of Munich, further examined these lines, and counted and mapped nearly 600 of them; but he did not account for their presence except by a vague suggestion that they were in some way caused by absorption, a supposition which has since proved to be correct. To account for the appearance of these dark lines, and also for that of other bright ones which are found in the spectra of incandescent gases, it is necessary to examine the effects of heat upon matter in its two states of solid and gaseous. If we gradually heat a non-volatile solid body, and examine the light which it emits, we find that it first gives off red rays, or in other words, becomes red hot. On slightly increasing the heat, it gives off yellow rays, becomes yellow hot, and as the heat is still increased, it emits successively green, blue, indigo, and violet rays, which by their combination form white light, and the body is now said to be white hot; and when the light from this white hot solid is examined by a prism, it is decomposed into all the colors which go to make up white light; and the spectrum thus obtained is perfectly continuous, and not crossed by lines. And this being true of all solids, the spectra of solids are in every case identical, and cannot be distinguished from each other.

With gases, however, it is different; if we heat, for instance, the vapor of soda, it never becomes red hot, but at once gives out yellow rays, and however greatly the heat is increased, it never evolves rays of a higher refrangibility than the yellow; and if the emitted light of incandescent soda vapor is examined by a prism, it appears in the yellow part of the spectrum as a bright band occupying a definite and unalterable position. If, however, instead of heating the soda vapor to incandescence and using it as a source of light, we interpose a stratum of cooler soda vapor between the source of light and the prism, we get the spectrum instead of the bright yellow line, and, occupying exactly its place, a black one caused by the absorption of the yellow rays by the atmosphere of soda vapor, through which they passed before reaching the prism. And so with other gases, each gas having the power of absorbing light of the same degree of refrangibility as that which, when incandescent, it gives off. This fact at once affords an explanation of the black lines which appear crossing the solar spectrum. They show that the solar atmosphere contains certain substances capable of absorbing light; and, by the exact coincidence of these black lines with the bright lines produced by certain terrestrial elements, we are fully justified in concluding that many metallic and other elements with which we are acquainted on the earth recur also in the atmosphere of the sun. The elements which have in this manner been recognized in the solar atmosphere are sodium, calcium, barium, magnesium, iron, chromium, nickel, copper, zinc, strontium, cadmium, cobalt, hydrogen, manganese, aluminium, and selenium. Since the moon and planets shine by reflecting the light of the sun, the spectroscope can afford no information as to their composition, but it is able to afford some clue as to the presence or absence of an atmosphere; and the results of spectroscopic observation tend to show that the moon has no atmosphere, but that this is present in the case of the other planets. The fixed stars being self-luminous, give characteristic spectra, and, as in the case of the sun, many of the dark lines correspond with those of terrestrial elements. Stars, moreover, differ in color; those which are bright to the naked eye show generally a tint of red, yellow, or orange, and with the telescope we may discover, in close companionship with these other, fainter ones of a blue, green, or purple color, and the cause of this difference is revealed by the spectra. We find that in the case of white stars, the dark absorptive lines are pretty equally distributed over the whole spectrum, which gives the characteristic color of the star.

The spectroscope has also afforded important assistance in the examination of the *nebulæ*. These bodies appear in the heavens as a faintly luminous haze, some of which, when examined by a powerful telescope, appears to be resolvable into a number of bright points; and long ago Sir William Herschel suggested that these *nebulæ* were the primordial matter out of which the existing stars have been formed.

Spectrum analysis, notwithstanding the difficulty of applying it to bodies so very faint, has afforded much valuable information regarding the physical distinction which separates the *nebulæ* from the fixed stars. The spectrum of the *nebulæ* consists of bright lines, showing them to consist of incandescent gaseous matter, and the same results are obtained from those *nebulæ* which appear to be resolved by the telescope, the only difference apparently being that the bright points consist of more dense, but still gaseous, matter than that composing the unresolvable ones.

From such experiments and observations as have been described, we appear to be justified in concluding that the sun consists of a white hot nucleus surrounded by a cooler atmosphere, containing many elements which are met with on the earth; that the fixed stars have a constitution analogous to that of the sun; and that the color of the stars depends upon the nature of the elements which occur in their atmosphere; whilst, with regard to the *nebulæ*, the experiments have perhaps not been yet sufficiently numerous to allow any definite theory being formed.

Silver Mining in Nevada---A Visit to some of the Mines.

After waiting a few minutes for one of the cages, as they are called (being large sheet iron boxes drawn up and lowered down by an everlasting windlass, propelled by steam power), to arrive at the surface, we spend the time in looking down, down, until nothing is discernible but the faint glimmer of a light, no larger than a twinkling star. The cage has arrived, and all aboard, our tour of inspection has begun. We experience none of the heat that was anticipated, as the draft of air formed by our descent has dispelled it. The cages go down very rapidly, and we could hardly believe that we were in motion until we were landed at the 700 feet level with a jar. Quickly jumping off the cage and lighting the candles handed to us, we follow our guide, finding the climate at this landing quite cool, as there is a strong current of air being forced continually down from above by means of large blowers made for the purpose. The passage on this level is about five feet wide, with a car track laid on sleepers, upon which small, open cars, drawn by mules, are run, carrying ore, working material, etc. There are smaller passages or drifts, as they are called, cut through here and there, while prospecting for pay rock. Now we go down innumerable ladders and inclines, preferring this more exciting method than the cage, and have a better view of the surroundings; pass the stables used for the underground animals, where the mules stand perfectly quiet and looking as contented as if they were aware that they had plenty to eat and very little to do; we have finally reached the 1,100 feet level. Pause, reader, and only think; 1,100 feet down in the bowels of the earth, among untold wealth waiting but to be carried away. Here we find the atmosphere very warm and the perspiration starts in streams. Going in an easterly direction, as the lead runs from east to west, we arrive at one of the many drifts, and finally pause for a moment and are asked to try our hand at the pick to see what kind of a miner we would make; nothing loth, we seize hold of one and begin our new labor, but are very soon exhausted and find our progress has been slow indeed, as nothing but a blast of powder will affect the rock. Being rather warm after our exertions, we concluded to start for more genial quarters; but being asked if we would not like to go over to the Belcher mine, we conclude to do so, and we wait for a load of timber, which was coming down the tunnel on one of the cages, to follow after it, meantime looking at the pumps, machinery, and workings of the incline cars, which come and go continually, laden with ore to the station, to be hoisted up in the cages.

The lumber has at last arrived, and is quickly transferred aboard one of the cars; and we are all prepared to follow its course, but the carman, a shrewd Yankee, quickly sees that we are strangers, and immediately whips his mule up on a keen run, and we after him as fast as strength and " foot and walker's line" will admit of; our candles are blown out, leaving us in almost total darkness, and forgetting to keep our bodies in a stooping position, our heads come in close contact with the beams above. Arriving at the "Belcher" out of breath, we again halt before the face of a rock they are at work upon, which is sixty feet wide, and the ore very rich. As fast as the quartz is taken out, they fill behind them with waste and timbers as a precaution against its caving in on them. The beams are twelve by fourteen inches, and placed every few feet apart, and cross braced so as to be as firm as possible; yet we notice some of the timbers twisted and broken in every conceivable shape by the enormous weight they have to withstand. Leaving this, the fifth level, we go up to the fourth and third levels, and are shown some of the richest ore in the mine, and are given some fine specimens of crystallized quartz to carry home with us. From here we are taken to see the cave-in that was had at the "Crown Point" a short time since, when thousands of tuns of rock fell, leaving the roof looking like a huge dome. Luckily the fall happened during the hour of noon, otherwise thirty human souls would have passed into eternity. In this part of the mine it is excessively warm, so much so that the men work in six hour shifts, and where it is cooler eight and ten; but little clothing suffices, some having a cloth only tied around their loins; yet all appear to be healthy enough and very stout. Starting back on our return, we meet with no stoppages until arriving again at the 1,100 feet level in the " Yellow Jacket," where we are told by Mr. D. that we have traversed from three to four miles, and been under nearly all the city of Gold Hill, and then seen but about half of the underground works. All aboard the cage again, and in about thirty seconds, after passing station after station, with a jar we are landed from our first starting point, and with a shiver change our clothes, having come from the torrid to the freezing zone in so short a space of time. We step outside of the building and are much surprised to find the stars shining brightly, as it was in the afternoon when we started on the descent.—*Philadelphia Post.*

The "Argento" Picture, by Mr. F. A. Wenderoth of Philadelphia.

The manipulations are briefly as follows: A carbon print is made by exposing a piece of carbon tissue, sensitized by bichromate of potash, under an ordinary negative, in th usual way of printing carbon prints. A metal plate with a silvered surface is taken and ribbed by rubbing it with a sanded brush, to deaden the polish and to give effect to the picture. The plate is then cleansed with spittle, nothing else answers the purpose as well, and then laid upon a sheet of paper on a table flowed with diluted alcohol. The carbon print is now laid face down upon the print, paper laid upon it, and a squeegee (made of a piece of wood and several thicknesses of ordinary bed ticking wrapped over one end) used to force out the superfluous alcohol between the picture and the plate, and to make the one adhere to the other. The alcohol also serves to prevent the occurrence of air bubbles.

The whole is now immersed in a pan of water of about 100° temperature, and developed in the usual way, leaving on the plate a picture, the shades of which consist of the colored gelatin and the lights, or rather, the highest lights of the surface of the plate exposed under colorless gelatin. This part of the operation, as all carbon printers know, is most fascinating and beautiful—more like the developing of a collodion plate than anything else. As soon as the superfluous color is all washed away, the pictures (now on the metal plates) are removed from the water, and hung upon a line by clips to dry.

To render them more lasting still (though a carbon print on a metal plate seems to be as permanent as anything can be) they are, when dry, hermetically sealed to glass in the following manner: A little stand should be provided, made of a plate of cast iron, say one quarter of an inch thick and twelve by twenty inches in size, smooth on the upper surface, riveted to a leg at each corner. This plate is heated with gas, or a coal oil stove, the heat being applied at one end, so that the end of the plate furthest from the heat will be considerably cooler than the other. Now lay the picture upon the iron plate at the warmest end. When it becomes warm, drop upon it a small piece of white wax, which will soon melt and naturally spread over the whole surface of the picture. Now, having first heated the glass, place it upon the surface of the picture, place them under a weight on the cooler end of your iron plate, where they will gradually cool and become effectually sealed together. They are then cleaned and mounted in a case or frame, as desired.

The results are very beautiful, and are made more brilliant by the metal plate on which they are mounted. The prints are made with " cut outs," so that, when finished, the white metal plate forms the margin, which adds greatly to the effect.

Waterproof Glue.

WE have recently met with a very useful form of cement for wooden or other similar articles which are employed for holding water or non-alcoholic liquids. Although the formula is not a very novel one, we know it to be useful and likely to suit the requirements of some of our readers. It stands as follows:—

Alcohol, (spirit of wine) 1 pint; sandarac, 1 ounce; mastic, 1 ounce; common white turpentine, 1 ounce; glue and isinglass, sufficient; water, sufficient. Dissolve the two resins—sandarac and mastic—in the spirit, and then add the turpentine to the solution. Make some very strong glue, and add to it a good pinch of isinglass. Now heat the alcoholic varnish until the liquid begins to boil, and then very slowly stir in the warm glue. The amount of the liquid glue to be added is determined by noting the point at which, after thorough mixture, a magma or thin paste is formed capable of being easily strained through cloth. When required for use, the strained mixture is to be warmed and applied like ordinary glue to the articles to be united. A strong junction is effected, which is not destroyed by cold water, and only after a comparatively considerable time by hot water or ordinary saline solutions.—*British Journal of Photography.*

EVERYTHING in nature indulges in amusement of some kind. The lightnings play, the winds whistle, the thunders roll, the snow flies, the rills and cascades sing and dance, the waves leap, the fields smile, the vines creep and run, the buds shoot, and the hills have tops to play with. But some of them have their seasons of melancholy. The tempests moan, the zephyrs sigh, the brooks murmur, and the mountains look blue.