LATENT SOLAR LIGHT.*

Translated from the French, by the Marchioness CLARA LANZA.

A remarkable stone, which plays quite an important role in ancient histoiy, is the carbuncle, literally translated, glowing coal, which shines and glimmers in the dark. Lucien relates that in the Temple of Hieropolis there is the statue of a Syrian goddess in whose forehead is placed a stone called *lychins* or lamp. This stone was moderately brilliant during the day, but at night it illuminated the temple from one end to the other. Shakespeare, in Titus Andronicus, says, while speaking of Prince Bassianus' body:

> "Upon his bloody finger, he doth wear
> A precious ring, that lightens all the hole,
> Which, like a taper in some monument,
> Doth shine upon the dead man's earthy cheeks."

It is said that formerly dwarfs and gnomes wore one of these stones upon their heads as miners carried their lamps. We have likewise been told that certain birds knew where to find them and make use of them to illumine their nests. The tendency which has been remarked in birds, notably crows, to pick up brilliant objects, has naturally given rise to numerous legends and anecdotes among all people, and it is declared that in America numbers of birds light up their nests by placing therein fire-flies. The carbuncle has still another secret property, for it renders the object it adorns, invisible both to man and beast. The question may therefore properly arise, how did man happen to discover this treasure which birds alone were apparently able to distinguish? Poetic fancy, we may say, has answered this query. The invisibility is caused by a ray of light which blinds the eye. A mirror, however, does not become so easily dazzled, and if, while walking along the edge of a brook, you perceive the reflection of a nest in the water, while with your naked eye you are unable to discover it, you may be sure that the stone is there. The legend of the carbuncle first arose in India, the land of precious stones, and it was founded upon the remarkable capacity possessed by many diamonds and a few rubies of shining for a long time in the dark after being exposed a few moments to the sun or merely broad day-light. This phenomenon appears to have been studied and experimented upon for the first time in Europe somewhere about the seventeenth century, by the celebrated naturalist, Boyle. In India, however, the knowledge of it can be traced back to the furthest antiquity, as can be proved by referring to a passage in the famous drama called *Sakuntala*, whose author certainly lived long before the beginning of our era. The passage is this:

"Among the just whose souls enjoy the most complete repose, there is a hidden radiance, which illumines them with its faint glimmer. Thus shines the precious sun stone, as soon as an outward ray of light strikes it."

At Bologna, which, as we know, is a well-known scientific centre, there lived at the beginning of the seventeenth century, a shoemaker named Vincenzo Cascariolo, who like many other men of his time, determined to discover primitive matter in the shape of the philosopher's stone, and by means of it,change the vilest and most worthless metals into pure gold. He had already experimented with fire and water upon all possible substances, organic and inorganic, when in 1604, some writers say 1612, he found, one day upon Mount Paderno, close to his own dwelling, a grayish-white stone, of a fibrous structure, and whose weight being considerable, made him suspect some unusual property. He calcinated a portion of it with some coal, and night falling while he was engaged in the operation, he saw with utter stupefaction, that the entire contents of his crucible, shone with a ruddy glow, although the furnace had become quite cold. With trembling hands he seized the stone, not doubting in the least that it was the famous philosophical one, of which he had so long been in search—still less did he doubt, when he observed afterwards, that only the fragments which were exposed to the sun or broad daylight were brilliant. Alchemists in those days called the sun a golden planet. In their works they employed an identical sign to designate both the luminary and the metal, and they firmly believed that the rays of the former penetrated the latter, as water is soaked into a sponge. This mysterious connection is clearly indicated in a brief opuscule discovered during the middle ages, no one knows exactly where, and of which there exists now only a Latin translation, the original, however, doubtless having been found in some Egyptian tomb. It is called "The Emerald Table of Hermes Trismegistus," and among other things it is therein stated that "the father of the Philosopher's Stone, is the sun, its mother the moon. Separate the earth from fire, and you will obtain the wonder of the world, all shadows will flee before you." These obscure words were applied to the new luminous body called phosphorus, and the phosphorescent stone of Bologna, excited the young disciples of chemistry, to the highest pitch of interest.

Although this substance did not at once realize the great expectations set abroad concerning it, and notwithstanding the fact that it was obliged to renounce entirely the *rôle* of philosopher's stone, it nevertheless caused its discoverer to make a considerable sum of money, for men seeking knowledge and instruction came from all countries to Bologna, and purchased this natural curiosity to a great extent. Poets likewise wrote laudatory Latin verses to the now celebrated shoemaker, comparing him to Prometheus who stole fire from heaven, and placed it on the earth. Enormous enthusiasm was manifested everywhere for this remarkable stone. Volumes were written about it, and it was even stated that the sun and moon were nothing more than huge masses of Bologna phosphorus. For a long time it was thought that the stone existed nowhere but at Bologna, but later it was discovered that it was composed principally of spar or sulphate of baryta, which was to be found in numerous places.

Alchemists gathered fresh hope in 1674, when Christian Balduinus, intendant at Grosenhain in Saxony obtained an analogous luminous body by the calcination of nitrate of lime. He called it hermetic phosphorus or solar gold, and in several works he declared that this was indeed the veritable philosopher's stone whose properties he was engaged in studying. The only German Naturalistic Society at that period was the "Leopold Academy of Natural Curiosities," and this organization received the new inventor into their midst under the honored title of Hermes, which has ever remained in the chemical world. Since then, it has always been supposed that the hermetic or philosophical stone must be luminous, and Dickinson, physician to Charles II. of England, relates in his "Old Physical Truths" (1702) that Noah, whom he regarded as one of the ancestors of hermetic science, had placed a large gleaming stone of some sort, called *zohar* in Hebrew, upon the top of his ark, so that he might have perpetual light during the night, and that moreover the scientific knowledge of this same Noah had caused him to nourish every animal in the ark with an extract made from the meat or plant which the creature preferred, thus economizing space and doing away with the necessity of removing from the ark such bones, leaves, skins, etc., which might otherwise have been there.

Chemical researches advanced with singular activity; for about the same time that Balduinus was performing his experiments, Brand, of Hamburg, an obstinate investigator discovered a substance which produced luminous vapor, and condensed itself into yellow drops that shone in the dark without being exposed to the sun. Professor Kirchmayer, of Wurtemburg, announced to

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the world emphatically, that the long sought for "perpetual light" had at last been found, while another enthusiastic novice wrote a work upon the *Phosphorus mirabilis* and its marvellous brilliancy. Here again the future did not justify all the hopes which might have been expected. This substance, however, which still goes by the name of phosphorus has become one of the necessities of our age.

Phosphorus gradually entered the scientific period. In 1768 an English chemist, Canton, obtained a new kind by calcinating oyster shells with sulphur, and it was finally discovered that the best absorbents of light were combinations of sulphur, calcium, baryum and strontium. However, other metallic sulphurets and various substances are equally capable of making in the dark what is called solar, magnetic or electric light. The method of preparation, of course, has considerable influence and lights of divers colors can be obtained according to the process employed. By calcinating sulphates with organic substances, or carbonates with sulphur, a very brilliant phosphorus can be obtained, consisting principally of baryta, another of lime, less luminous and a third of strontium, which gives forth a very feeble light. Sulphate of baryta gives a phosphorescent product of an orange color. When the sulphate is prepared artificially the light is greenish.

Later, Ozarm obtained other luminous bodies by calcinating lime with sulphate of arsenic or sulphate of antimony, while another chemist, Bach, by heating sulphur with calcinated oyster shells which had probably been washed with a solution of ammoniac and realgar, procured a phosphorus so brilliant that its light was even visible during the day.

It is by this means, or others which are similar, that the luminous flowers are prepared which lately have appeared to such an extent. They are covered with some phosphorescent substance which makes them glimmer in the dark with a beautiful bluish light. The luminous matter is pulverized and applied to the object by means of a varnish or anything else that will stick. By employing phosphorus of different colors very pretty effects can be produced, bouquets of all shades, glittering butterflies, luminous inscriptions, etc. But the most interesting of all is undoubtedly luminous photography, which is made by placing a paper covered with phosphorescent powder behind the glass negative of a photograph. Heat brings out the luminous qualities as well as light, and very peculiar and beautiful effects can be obtained by writing upon such a paper as has just been described with a pointed piece of heated metal.

Unfortunately these interesting amusements are not eligible as regards trade, for as soon as it is exposed to the air sulphuric luminous matter gradually loses its properties and acquires the disagreeable odor of spoiled eggs, while the object by the end of a week or two is not phosphorescent at all. On the other hand, it can be very well preserved by putting it into air-tight glass tubes, and phosphorus of all colors thus prepared can be had from Geissler's establishment in Bonn. It has been proposed to make inscriptions of these tubes for the night bells of hotels, physicians' houses and druggists' shops, the daylight being sufficient to make them very luminous at night. Another idea, conceived by Gustave Ullig, is to make the faces of watches and clocks phosphorescent, as the glass covering them would be a protection against destruction.

As to the physical explanation of phosphorescence, it was thought for a long time that the light was composed of little eddies or whirlpools of subtile matter, and that sunlight became condensed and accumulated in them. Later, when it was known that light is only a vibratory movement, and that the phosphorus on the end of matches only burns because it is united with the oxide in the air, it was thought that in all the old phosphorescent substances the light was produced alone under the influence of a slight oxidation. This explanation, however, is false, and only during the last century was the true one made known by a celebrated German physician named Euler.

It is generally believed that the planets, the tops of mountains, and all celestial bodies, are visible, simply because they reflect the rays of the sun. This is also false. Brilliant surfaces alone, more or less, reflect light, others absorb it on the contrary, and cause vibration just as a musical sound makes all the objects which it strikes vibrate. Certain surfaces, however, can only reproduce certain vibrations (blue or red for example) of solar light, which is composed of the vibrations of the seven prismatic colors, and when these vibrations are repeated in our eye, the surfaces appear to us blue or red, as the case may be.

In the same way that consecutive vibrations can be determined after sound, so phosphorescence succeeds the action of light. Euler affirmed that the greater number of bodies would present these luminous vibrations if they were observed immediately after they had been exposed to the sun, and if a continued sitting in the dark had rendered the eyes of the observer very sensible. The French physician, Becquerel, constructed an instrument about twenty years ago called the phosphoroscope, by means of which he demonstrated that most substances, paper, stone, oyster shells, etc., shone for a short time after being exposed to the light, that is to say, a second or the fraction of a second, and that solar phosphorus was only distinguishable from other bodies by the persistence of this property. But whether this assertion be true, generally speaking, or not, the subject itself is not by any means simple, and there are a mass of circumstances of which we must take account.

Modern physics teach us that a number of bodies, notably colored organic matter and some metallic combinations, become phosphorescent, but only when they are lighted. This sounds like a paradox, but facts can prove the assertion. There are certain substances, both liquid and solid, which by reflected light appear to have another color than the one transmitted. A peculiar emission of rays can also be observed upon the surface. Petroleum, solutions of sulphate of quinine, decoctions of Indian bark, etc., emit bluish rays; the etherized extract of green leaves, blood red rays; uranium glass, which is pale green and used principally in the manufacture of Rhine wine glasses, emits reddish yellow rays. If any of these dichroic subtances are selected and placed in a dark room lighted only by an electric current traversing a glass tube, they will shine brilliantly, each one in its particular color, certainly with more splendor than the electric light, and yet only while the latter illumines them. How is this curious phenomenon to be explained? How can a feeble light produce such a brilliant one?

It has been said above that white light is composed of seven colors, or, more properly speaking, of an infinite number of colors, which after their dispersion from the prism separate one from the other and form a long band. The red rays are those which vibrate the slowest, and the violets those which vibrate the most rapidly. But just as there are in addition to the red rays others which vibrate slower still and are manifested not as luminous rays, but calorific ones, so there are besides the violets, ultra violet rays which vibrate so quickly that we cannot directly perceive them, although they are known by their energetic chemical action. This is notably the case in photography, and for this reason they are termed chemical rays, or invisible light. A pale, electric light, is a peculiarity of these rays, and the latter give to certain bodies that remarkable dichroic radiance which has been called fluorescence, because it was observed for the first time in fluor-spath. However, if on one side these rays produce a light which cannot be perceived by our retina owing to the extreme rapidity of their vibrations, on the other, the bodies thus illuminated should be able to diminish the rapidity by vibrating themselves more slowly, and thus render the rays visible. Ultra violet rays could consequently be transformed into violet, blue or green; blue rays into yellow or red. What generally happens, however, is that they change red rays to purely calorific ones and thus make them invisible.

We must here make several important observations. First of all, violet rays do not only produce the greatest fluorescence, but also the greatest phosphorescence. Red rays produce neither the one nor the other. Luminous or dichroic substances give a light differing from that which they receive. It has been demonstrated, finally, that the closest relationship exists between the two phenomena—That fluorescence can be considered as an intense phosphorescence which can be seen in broad daylight, but which dies with the light which gave it birth, while phosphorescence is only a feeble but persistent fluorescence.

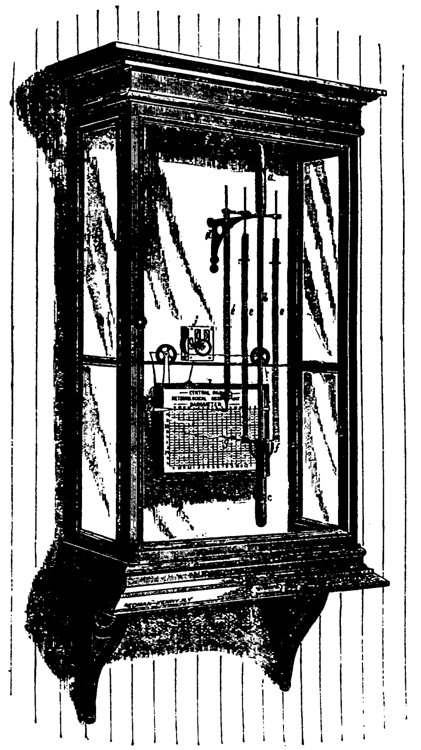
"Solar phosphorus" generally reproduces luminous vibrations even when it has ceased to receive the latter, and it can transform calorific rays into luminous ones. A diamond acts in this way, also fluor-spath, and nearly all artificial phosphorus. One of the last named gives forth a light of various colors, if it is heated to different degrees after being exposed to the light. Sulphate of strontium produces a deep purple light at 20°, a violet light at 15°, blue at 40°, bluish-green at 70°, greenish-yellow at 100°, and reddish-yellow at 200°,

Moreover, phosphorescence, like fluorescence, can be produced by means of an electric light rich in chemical rays. If you expose to such a light a flower, a butterfly or any other object covered with phosphorescent powder, it will assume a magnificent appearance. The English chemist, Crookes, prepared diamonds and rubies in this way, by enclosing them in an air-tight glass ball placed in the immediate vicinity of the negative pole, from which a luminous current issued. The effect was superb, recalling all sorts of fairy stories. Some African diamonds shone with a brilliant blue light, and a large greenish one produced such an intense radiance that it almost looked like a lighted candle. In fact the light was quite sufficient to read by, and the history of that famous stone in the Temple of Hieropolis seemed really probable. A collection of small diamonds from various countries, placed in any receptacle that is air-tight, will produce parti-colored fiery lights, blue, pink, red, orange, yellow, green and pale green, all mingling together.

In a third recipient, Crookes placed a quantity of uncut rubies, which, when the electric light fell upon them shone with such a gorgeous red flame that they appeared to be incandescent. Artificial rubies prepared by Feil in Paris gave as brilliant a light as the real ones, and white crystals became rose-colored or deep red. Such wonderful carbuncles would have astonished even the authors of the old legends.

A CURIOUS thing occurred lately in the works of M. Fleury, at Cette (Hérault). The feed-water of the boiler giving much incrustation, M. Fleury was advised to put into the boiler some fragments of zinc as a de-incrustant, and did so. In a few days, spite of oiling, the steam-engine began to work very badly, the piston catching a great deal, and it soon became necessary to stop and make examination. The piston was found to be covered with a thick adherent layer of copper. It was put on the lathe, and at certain ovalised points, the metallic layers were so thick that the tool worked in copper alone. The explanation given by M. Fleury is this: The boiler was connected with the engine by copper pipes. Particles of zinc carried off by the steam would form with the copper numberless small galvanic couples; hence the transport of copper to the piston, which would principally attract them by reason of its motion, and of the heating produced. It is remarked in *Les Mondes*, that the eminently electric properties of expanding steam may have helped in development of the phenomenon.

DRAPER'S SELF-RECORDING, MERCURIAL BAROMETER.



We are indebted to Dr. Daniel Draper for preparing an abstract of his weekly Meteorological report for this journal, the third of which appears this day in another column.

Dr. D. Draper is director of the Meteorological Observatory of the Department of Public Works, Central Park, where all observations are made by self-recording instruments, especially designed and arranged for this purpose.

The great object Dr. Draper had in view when designing these instruments, was to combine simplicity of construction with perfect efficiency. His great success is well known to all familiar with Meteorological Science, and we propose in the course of a few articles to fully describe these instruments, and illustrate the subject with excellent wood cuts.

We commence the series with a description of the apparatus for recording Barometric observations.

"I was led to construct this form of barometer from the fact that with the photographic one it cannot be told what the atmospheric fluctuations are until the next morning, when the photographic plate is developed. Even then, if there has been much variation in temperature, it alters the sensitiveness of the collodion film, so that it is very difficult to read the tracing. The construction of the pencil instrument is as follows:

In the pencil barometer the glass tube is 36 inches in length, the upper portion being of larger diameter than the lower; it is held firmly in a fixed position, and filled in the usual manner with quicksilver; its lower or open end dips into a tube or reservoir containing the same metal. This reservoir is suspended on two spiral steel springs, and has freedom of motion up and down. When the pressure of the atmosphere diminishes, a portion of the mercury flows out of the tube into the reservoir; this becoming heavier, stretches the steel springs, causing the ink pencil fastened to them to mark downwards. If the pressure increases the reverse movement takes place. The ink pencil makes its mark on a ruled paper register,