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## STREET ILLUMINATION.

Almost the first thing that strikes the scientific economist, when gazing upward in admiration at one or other of the numerous electric lights now being introduced in our streets, is the extremely small percentage of the light really utilized for achieving the purpose intended, viz., the effective lighting of the streets and thoroughfares. Somewhat more than one-half of the light emitted is totally lost, a fact scarcely requisite to be pointed out to any one acquainted with the rudiments of optical science, seeing that all light that passes upward into space rather than in the direction into which it is required must, for that requirement, be assumed to have no existence. The fifty per cent passing upward and outward is not more metaphorically than literally *in nubibus*.

The value of reflectors for projecting light in any required path is well recognized by all, but the proper application of the principles of reflection and diffusion appears in a large measure to be lost sight of. Divested of the reflectors or refractors to which they owe their efficiency, of what value would be the lamp in the lighthouse, at the pier-head, or affixed to that of the railway locomotive?

A parabolic reflector is that which utilizes to the greatest extent the light emanating from any lamp; but owing to the very perfection of this form it is quite unserviceable in aiding street illumination, the conditions of which demand something entirely different from those subserved by that perfect reflector. What is wanted is *radiation* rather than reflection in the optical sense of the term. A reflector is a polished surface, any one part of which reflects light from a radiant according to the law of the angle of incidence being equal to that of reflection; a radiator, on the contrary, possesses a surface from which is emitted in every direction the light that falls upon it. A silvered glass or polished metallic surface represents the former; a type of the latter being a sheet of white cardboard, a surface of porcelain, or of silver deposited upon ground glass. Unsilvered ground glass, translucent porcelain, or even a sheet of tissue paper, placed in front of a light, also act as radiators.

What is required to render perfect our system of street illumination by electric lamps is that all the light which is now lost by passing upward shall, by means of a bright radiating surface of a tolerably large area, be arrested and projected downward in the direction where it is really required. Dimension in the radiator is of importance, inasmuch as this forms a condition of softness and diffusiveness of the light. From several experiments which have been tried on a small scale, it is believed that a valuable means for utilizing in the most efficient manner the light from the electric lamp is to have erected over and at no great distance from it a nearly flat circular plate of coarsely ground glass coated with silver, according to the manner recently described in the SCIENTIFIC AMERICAN. The ground surface should be farthest from the light, and the deposit of silver protected first by a coating of varnish and afterward by a casing of thin metal. This insures the reflecting surface against becoming impaired by atmospheric or other deleterious influences. But it is also an essential part of this radiating "reflector" that it be surrounded by a deep edge, also of silvered glass, beveled outward in such a degree as to prevent any rays from passing out in a horizontal direction (that is, if the electric lamp be erected high overhead), but so as to arrest and diffuse them downward, which, by a proper selection of the angle at which the bevel is given to the edge, can be done so as to cause the greatest benefit to be received by those parts at a distance away from the lamp.

In such cases where it is desirable to hide the light itself from the eye this may be done in the best manner by the interposition of a plate of ground glass, which, of all other diffusers or radiators, is found to absorb less of the light than any other diaphanous body. Some kinds of porcelain shades are known to absorb sixty per cent of the light; to ground glass such an objection cannot apply.

## AUNRECOGNIZED QUALITIES IN CHARCOAL.

Among the numerous and varied properties possessed by charcoal there is one—one, too, of the most wonderful—which does not seem to be adequately recognized, probably from its being imperfectly known except to physicists. It is that of being able to condense and store away in its pores many times its own bulk of certain gaseous bodies, which it retains, thus compressed in an otherwise unaltered condition, and from which they can be withdrawn, as required, as from a reservoir.

That eminent scientist, M. Saussure, undertook the task of a systematic examination of this subject, with a result which will prove surprising to the general reader. Operating with blocks of fine boxwood charcoal, freshly burnt, he found that by simply placing such blocks in contact with certain gases they absorbed them in the following proportions:

|                                   |      |          |
|-----------------------------------|------|----------|
| Ammonia.....                      | 90   | volumes. |
| Hydrochloric acid gas.....        | 85   | "        |
| Sulphurous acid.....              | 65   | "        |
| Sulphureted hydrogen.....         | 55   | "        |
| Nitrous oxide (laughing gas)..... | 40   | "        |
| Carbonic acid.....                | 35   | "        |
| Carbonic oxide.....               | 9 42 | "        |
| Oxygen.....                       | 9 25 | "        |
| Nitrogen.....                     | 6 50 | "        |
| Carbureted hydrogen.....          | 5    | "        |
| Hydrogen.....                     | 1 75 | "        |

It is this enormous absorptive power that renders of so much value a comparatively slight sprinkling of charcoal over dead animal matter as a preventive of the escape of the odors arising from decomposition. A dead dog having been placed in a box in the warm laboratory of an eminent chemist, and covered with charcoal to the depth of between

two and three inches, could not be discovered to have emitted any smell during several months, after which time an examination showed that nothing of the animal remained but the bones and a small portion of the skin. To the large excess of oxygen over the nitrogen in the atmosphere, which, according to the above table, was absorbed by the charcoal, and which thus rendered harmless the noxious vapors given off by the carcass as they were being absorbed, is doubtless owing the fact above stated and the further fact of the charcoal never becoming saturated.

A reader of the SCIENTIFIC AMERICAN who has been trying certain experiments on the value of charcoal as a convenient means of storing oxygen, reports favorably as to the results. In a box or case containing one cubic foot of charcoal, may be stored, without mechanical compression, a little over nine cubic feet of oxygen, representing a mechanical pressure of a hundred and twenty-six pounds on the square inch. From the store thus preserved the oxygen can be drawn by a small hand pump.

From the fact of the charcoal absorbing oxygen in so much greater proportion than nitrogen, we have here a means of utilizing its discriminative powers of selection in obtaining unlimited supplies of oxygen from the atmosphere, which contains nitrogen five times in excess of its oxygen, or twenty per cent; whereas by the separating or selective powers of the charcoal the mixed gases capable of being extracted from it contain over sixty per cent of oxygen. It only suffices to withdraw this now highly oxygenized air into another vessel of charcoal, by the further exposure to which the proportion of oxygen will be increased to a still greater extent. This indicates a most feasible means by which atmospheric air can be decomposed in such a way as to provide a cheap supply of oxygen.

One cannot readily recognize the fact, which is nevertheless true, that the condensing power of charcoal as applied to ammonia is equal to what would be obtained by subjecting this gas to a pressure of nearly one thousand two hundred and sixty pounds on the square inch.

## ELECTRIC SIGNALS FOR THE NEW YORK ELEVATED RAILWAYS.

A series of utterly inexcusable accidents have occurred on the elevated railways of this city, for which reasonable men will, we think, hold the companies responsible. It is easy to make a show of shifting this responsibility upon employees; but, so long as the companies persist in running these roads without providing electric signals, and all the other safety appliances used on our railroads, the recurrence of collisions, derailment at misplaced switches, etc., may certainly be expected.

The neglect to provide electric signals is all the more culpable when the comparatively small outlay required to supply them is considered.

The theory that accidents can be avoided on a double-track road when trains on the same track run all in one direction, has been over and again disproved by facts, and though the list of accidents has, as yet, resulted in little loss of life and small personal injury, this has been due rather to a fortunate concurrence of circumstances than to anything else.

Steps should be taken to compel the companies to provide every known means for securing the safety of the many thousands of people who daily trust their lives upon the elevated railways. The holders of these monopolies should be made to feel the full weight of public opinion till they yield to all reasonable demands for the public safety.

Suitable legislation, which we do not believe they could successfully obstruct or defeat, should be at once begun to compel what they do not seem disposed to voluntarily perform.

## GAS IN STEEL AND GLASS MAKING.

A few years ago every maker of crucible steel in the city of Pittsburg surrounded his frail pots of clay and plumbago with coke, the direct heat from this fuel melting the metal. To-day finds every one of these furnaces discarded, and the regenerative Siemens gas furnace has supplanted the coke burning ones. As a consequence, instead of two heats, five or even six heats are obtained from each crucible, while the saving in fuel is a notable item. The gas producing furnace is fed with a grade of bituminous coal which in many cases can be had for the hauling. Such in brief is an outline of the results attained in the use of gas in steel making.

Very recently a glass manufacturer of Pittsburg has, with remarkable success, adopted gas as a fuel in the converting of a "batch" of ingredients into molten glass, and his little furnace is an object of the deepest interest to the glass makers of Pittsburg and elsewhere. The glass melting furnace of the present is in principle that of the furnace of a century ago, a towering mass of refractory brick, holding at its base a collection of costly and fragile "pots," containing usually 2,000 pounds of molten glass each, these pots being exposed to the direct heat of burning coal beneath. The extreme tenderness of these pots, their liability to deposit their costly contents into the ash pit, their first cost, about \$50, and the care necessary in preserving them from sudden lowering of temperature are a few only of the objections that have always existed in the orthodox form of furnace. In the best of these a pound of melted glass produced for a pound of coal burned is considered extremely good results and the first cost of such a furnace is \$6,000. On the other hand, the new gas burning furnace costs \$500, and in it every day there is melted a 6,000 pound batch with 1,000 pounds of "nut"

coal in 12 hours, after lighting the fires, against 24 to 36 hours in the old furnace.

The new or "open tank" glass furnace is built of fire-brick, and is of the subjoined modest proportions. The "tank," holding 6,000 pounds of glass, is 7 by 5 by 2 feet. Across one end of this space, and separated from it by a fire wall, is the furnace or fire box. This is simply a fireplace, 30 inches square, furnished with grate bars, and not differing in appearance from the ordinary furnace under a steam boiler. To this fire box is led air from a rotary blower. This finds its way to the grate bars and through flues in the surrounding wall. In the latter instance this air becomes intensely hot before escaping through suitable openings and mingling with the products of the burning coal. So mingled, air, smoke, and gases blend in a flame of intense heat, and following the draught pour over the fire wall and down upon the tank, converting the "batch" into molten glass in the time stated. It should be added that the old style furnace, with its great mass of brickwork, requires two weeks of continuous firing to make ready for melting, and that skilled labor, "teasing," is necessary to properly preserve the pots from undue heat or cold.

The new furnace is the invention of Mr. Thomas Atterbury, of Pittsburg, and an inspection of the operation of the gas furnace warrants the supposition that the days of the old style and time honored furnace are numbered.

#### TREES IN CITIES.

An interesting paper has been recently read by Dr. Phené at Edinburgh on the benefits to be derived from planting trees in cities. Among the beneficial results to be attained are, he stated, the relief to the optic nerve through the eye resting on objects of a green color. Just that which is effected by the use of green or blue glasses in strengthening and sustaining the power of sight, is attained, or, at any rate, much aided, by the presence of green in nature; and in streets the only method to procure this result is by planting trees. It was pointed out by the author that wherever opportunity exists nature provides green and blue (the latter being the same color minus the presence of yellow), and that as the absence of color produces snow blindness, and in tropical calms, where the ocean presents only a white reflected light from a uniform glassy surface, reduced optical power soon follows a long continuance of the absence of blue color, which becomes immediately apparent on motion of the waves.

So in the streets, to the occupants of houses having a northern aspect, the glare of the reflected light is injurious; but the effect would be much modified by the coolness to the eye produced by the green of trees. In ancient surgery, persons having weak or declining sight were advised to look at the emerald. In the old style of building, the streets being narrow, were both cooler, from the sun not being able to penetrate them with direct rays, and less subject to noxious exhalations from the scouring and purifying effects of the searching air to which the narrow streets were subject, so that while there was no space for trees there was also less necessity. Wide streets, on the contrary, are hotter, and require the shade of trees to cool them; and, as in the case of London, which had so far done without trees in its streets, it was pointed out that not only are modern streets compulsorily wide, but that the enormous increase in metropolitan buildings render every sanitary question one of importance; and the chemical properties of trees as shown by experiment give them an important standing, irrespective of ornament or the pleasure they produce. Some of Dr. Phené's experiments on this subject have extended over a period of thirty years, and he it was who first tried the planting of trees in the streets of London. Since the reading of a former paper by him at Manchester, wherein the importance of the subject was pointed out, a number of streets in wealthy localities have been planted, and even Trafalgar Square, in the heart of the metropolis.

#### SINGULAR DISCOVERY IN CONNECTION WITH PHOSPHORESCENCE.

The property possessed by certain metallic sulphides and other phosphorescent bodies of absorbing light when exposed to its influence, and giving out the same when brought into a darkened room, has long been known to scientists, but it is only quite lately that efforts have been made to utilize such properties. Of these, the most striking consisted in spreading a sulphide of this nature upon a flat tablet and exposing it to strong light for a few seconds under an ordinary photographic negative. Upon removing the tablet thus impressed into a dark room, the picture on it will be found to be glowing in quite a mysterious and wonderful manner, and it will continue for some minutes to radiate the light which it absorbed.

It has occurred to an ingenious physicist, A. L. Henderson, to mix one of the most sensitive of these phosphorescent metallic sulphides with the bromide of silver, now so generally employed in the preparation of photographic dry plates, and, after emulsifying this mixture with gelatine, spreading it upon the surface of glass plates, and treating the same as ordinary ones except in so far as regards the exposure, which must be momentary. He appears to have reasoned in this way: With even the briefest exposure capable of being given, a certain modicum of change will be produced on the sensitive bromide of silver, although manifestly such as will be incapable of yielding a properly developed image. But the light also falls upon the atoms of the phosphorescent powder incorpo-

rated in the films: and as these in turn radiate such light, it follows that they will complete the imperfect exposure set up in the bromide by the direct action of the light.

This reasoning has been found correct, and the result at present stands that plates have been prepared having such exceeding sensitiveness as to be well impressed by what Mr. Henderson designates "the flash of a match."

Phosphorescent sulphides may easily be prepared by heating the carbonate of lime, of barytes, of strontia, or other carbonate found most suitable, in a covered crucible with half its weight of sulphur. After an hour's exposure to heat the preparation is complete and phosphori are obtained which, upon being briefly exposed to light and then withdrawn into a dark room, will be seen to glow brightly, the color of the light emitted depending upon the nature of the carbonate originally selected.

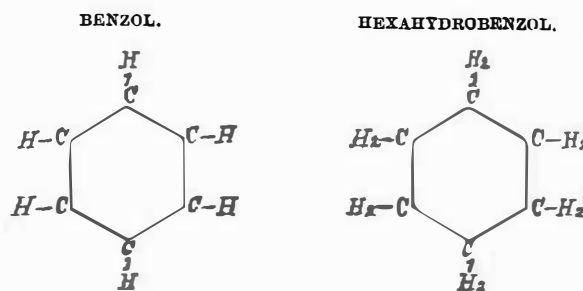
This application of a well recognized fact in phosphorescence is so novel, and calculated to be of so much use, that we have no doubt its progress toward development will be rapid.

#### A DESCRIPTION OF CAUCASIAN PETROLEUM.

It has been known for years, if not for centuries, that combustible gases escaped from the earth at Baku, in the Caucasus, yet no one seems to have suspected that Baku was destined to become as famous for its oil springs as our own Pennsylvania. Recently, however, the production of Caucasian petroleum has been such as to interfere with the sale of American petroleum in Russia. Two of the foremost chemists of St. Petersburg, Messrs. Beilstein and Kurbatow, have subjected this oil to a critical examination, which is given in full in the *Berichte* of the German Chemical Society.

The peculiarity of this petroleum from Baku consists of its high specific gravity as compared with American petroleum of the same boiling point. For a long time this fact caused the consumers to be mistrustful of their own oil. Wilm and Biel, however, proved that the Russian oil gave ten per cent more light than the American, and Biel also found that the illuminating oil even of this high gravity was drawn up the wick to the flame more easily than the American oil. Since that time the public prejudice has disappeared, and the importation of American oil into Russia has as good as ceased entirely. The high gravity of Caucasian oils is taken advantage of by the manufacturers of lubricating oil, and at present a lubricator with a gravity of 0.940 is made without adding any solid substance, which has already found extensive use in Europe.

The oils examined by Beilstein and Kurbatow was the first distillate obtained by a careful distillation of crude oil. Although they submitted it to fractional distillation nine times with the aid of Glinsky's dephlegmator, they did not succeed in obtaining any products with constant boiling points. That which boiled below 176° Fah. had a specific gravity of 0.717, while American petroleum of like boiling point had a specific gravity of only 0.669. The portion distilling over between 200° and 212° had a density of 0.748, the American of 0.699. At first they were inclined to attribute this to the admixture of hydrocarbons of the aromatic series like benzol,  $C_6H_6$ ; toluol,  $C_7H_8$ , etc. On shaking it with fuming sulphuric acid they were unable to detect a trace of any aromatic hydrocarbon. An ultimate analysis of that boiling about 185° corresponded nearly with the formula  $C_7H_{14}$ , while the American oil of 205° to 212° is nearly  $C_7H_{16}$ , showing that the Caucasian petroleum is poorer in hydrogen than the American. Yet it does not consist of homologues of ethylen ( $C_2H_4$ ), because bromine did not act upon it until heated, when hydrobromic acid was copiously evolved, showing that substitution had not taken place. A farther study of these products convinced these investigators that they were dealing with the hydrogen addition products of aromatic hydrocarbons, such as hexahydrobenzol  $C_6H_{12}$ , hexahydrotoluol  $C_7H_{14}$ . The graphic formula of the former is given below:



A very unusual circumstance for a petroleum was the action of nitric acid (sp. gr. 1.38). When boiled until red fumes ceased the acid liquid contained acetic and succinic acids; the oily portion contained a liquid boiling at 410° to 420° Fah., and having the formula,  $C_6H_{11}NO_2$ . This may be either a nitrous ether, or a true nitro-compound, a very surprising fact in petroleum.

The different petroleum wells of the Caucasus yield oil of varying composition, according to their situations. Those examined came from the wells of Messrs. Von Benkendorff. Others will soon be examined by the same persons.

October 8, 1880.

B. B.

#### Chemical Research by Means of Photography.

By the use of the electrical spark and a photographic apparatus the presence of very minute quantities of certain substances in certain liquids may be readily detected. The

liquid to be examined is placed in a vessel, the sides of which are composed of quartz, which is one of the few purely transparent substances. If one part, by weight, of the coloring matter known as anthracene is mixed with fifty million times its weight of alcohol the presence of the color may be detected by a gelatine plate photograph taken as above, which will show the characteristic bands of the absorbed rays pertaining to anthracene.

#### ELECTRO-METALLURGY.

##### SILVER DEPOSITS.

For electro-silver plating the double salt of silver and potassium cyanide is almost universally employed. The baths are used either hot or cold. The latter method is generally adopted for articles which require great solidity. The hot process is used for small articles, and is preferable for steel, iron, zinc, lead, and tin, which have been previously electro-coppered. The hot baths are generally kept in enameled cast iron kettles, and the articles are either suspended or moved constantly about in them. A somewhat energetic current is needed, especially when the articles are moved about in order to operate rapidly. A gray or black deposit indicates too strong a current, and when the surface becomes covered with bubbles of gas the same thing is indicated. The anodes are plates of silver or heavy silver foil. The wooden tanks for the cold baths are similar to those used in plating with copper and nickel, but should be very thoroughly coated on the inside with gutta-percha.

##### THE BATH.

|                                  |           |
|----------------------------------|-----------|
| Water (soft).....                | 1 gallon. |
| Cyanide of potassium (pure)..... | 8 ounces. |
| Nitrate of silver.....           | 5/4 "     |

Dissolve the nitrate of silver in a sufficient quantity of pure water (soft), and add to it gradually, with constant stirring, hydrocyanic (prussic) acid until all the silver has been precipitated as cyanide, which may be known by the formation of no cloud in a portion of the clear liquid when a drop of the acid is added to it—avoid adding an excess of the acid. Throw the precipitate upon a fine cotton cloth filter, and as the liquid runs through wash the precipitate on the cloth several times with pure water. Dissolve the cyanide of potassium in the water, and stir in the cyanide of silver carefully removed from the cloth. If it does not dissolve in the liquid entirely, add more cyanide of potassium until it does, stirring continually. Let the impurities settle, and the bath is ready for use. Many electroplaters use a preliminary or silver "whitening" bath, which is the same composition, but contains less silver, more cyanide, and is worked with a somewhat stronger current.

The cleaned article in some cases is first dipped for a few moments in a solution of nitrate of mercury, one ounce in one gallon of water, and then in the whitening bath for a few minutes, and after brushing is transferred to the silver bath proper.

The vessels containing the cold bath are sufficiently high to allow about four inches of liquid above the immersed objects, whose distance from the bottom and sides should be nearly the same to give a regular deposit of metal at both ends of the object.

The upper ledge of the trough carries two brass rods all around, which do not touch one another, one above the other, so that other metallic rods placed transversely will rest upon the higher or lower series of rods only. The upper rods are connected with the zinc, the lower with the carbon or copper end of the battery, or with the corresponding poles of the dynamo-electric machine. The transverse rods resting upon the lower set support the silver anodes; those resting on the upper set, the work. The work suspended from an upper transverse is placed so as to face two anodes suspended from two lower transverse rods.

As the lower layers of the bath are apt to become denser (richer) than the upper, it is often necessary to reverse the articles during the operation to obtain a perfectly uniform thickness of deposit. For the same purpose small articles should be kept in motion as much as possible.

The deposit is finer and denser if obtained with a weak battery and long exposure than if a strong current is employed. A sufficient quantity of silver may be deposited in three or four hours, but it will be of much finer quality and more easily burnished if the work is left in the bath for twelve or fifteen hours with a few cells of battery.

When the articles, especially coppered iron, etc., have acquired a coherent film of silver, they are sometimes removed from the bath and thoroughly scratch-brushed, cleansed in alcohol, or preferably in a hot silvering bath, thence again passed through the mercurial solution and finished in the cold plating bath.

The first scratch-brushing, which is not always necessary, obviates the tendency of certain alloys to assume a crystalline appearance and corrects the imperfections of the cleansing in process.

Should the anodes become black during the passage of the current the solution contains too little cyanide. In this the deposit is adherent, but too slow; and the bath loses more silver than it can gain from the anodes.

If the anodes remain white during the passage of the current the bath contains an excess of cyanide, and the deposit does not properly adhere; correct by adding cyanide of silver until it dissolves with difficulty.

When in good working order the anodes present a gray appearance while the current is passing, becoming white when circuit is broken.