HUMBLE GENIUS UNHONORED

Contribution of a Pittsburg Druggist to the Progress of Mankind.

PUT GLOBE AROUND KEROSENE FLAME

Made Night Work Possible and Brightened Path of Civilization—Later Lights and Their Development.

Dr. David T. Day of the United States geological survey, in a paper on "Light, the Civilizer," in the American Illustrated Magazine, presents an interesting and plausible claim that the humble Pittsburg merchant who put a glass globe around a kerosene flame, producing a steady light for night work, contributed more to the spread of civilization and education than Watt, Stephenson, Fulton or Edison. Supplementing the writer's claim is an instructive review of the development of light. The paper follows:

If Charles Lamb could return today to write a sequel to his "Popular Fallacies," he might well give the place of honor to the idea that the last century was an era of phenomenal growth in the material welfare and prosperity of mankind. It was not. The statement would be equally true or false, of the last two or the last three centuries. The last hundred years called forth the discoveries and inventions of several remarkable minds, such as Faraday and Ericsson, but many, perhaps most, of the ideas fundamental to our material prosperity belong to the preceding century, to Watt, Lavoisier, Galvani, Volta and their peers. Further, it is not these ideas but their universal application that constitutes material welfare, and the nineteenth century as a whole is no more responsible for their application than for their utterance.

The sudden increase in the speed of material progress, with which we are so familiar, belongs not to the century but solely to its latter half, and mainly to its last quarter. In 1850, though the great inventions, the steamboat, the railway, the telegraph, the sewing machine and so on were in use to some extent, though most of the fundamental ideas had been laid down and their application had already increased the luxury of a limited class, the comfort of the average citizen of civilized nations, and the development of the average thinking mind, had advanced no further, since 1800, than in previous half centuries.

The unexampled growth in comfort and intelligence in the last half century was chiefly due, not to the great scientists and educators, but to the fortunate coincidence of a chain of intrinsically insignificant events. Its cradle was the unromantic vicinity of Pittsburg, Pa., and most of its prime factors are familiar to the point of contempt.

About 1847 a Scotch chemist, James Young, began a series of experiments in Glasgow in the distillation of mineral oil from bituminous shales. Later he came to Boston, Mass., and continued his experiments on the shales, coals and asphalts shipped to that point from Canada and elsewhere. Others, following him, exploited the still richer shales of Kentucky, and the news of this exploitation came to Pennsylvania and West Virginia, where oil already distilled by nature was being found in boring brine wells. This oil was a nuisance to the brine prospectors. A little of it was bottled and sold as a medicine.

Oil as an Illuminant.

Fortunately for the world, Pennsylvania oil, with its high proportion of volatile ingredients, naphtha, gasoline and the like, was too explosive in its natural state for a fuel or an illuminant. Pittsburg, moved by the success of the shale distillations, began trying to refine it. And this brought it to the notice of the greatest modern benefactor of mankind, Samuel M. Kier. Kier was a Pittsburg druggist, a humble person who had been selling oil as a patent medicine, "Kier's Petroleum." Like other patent medicine dealers, he had a gift of utilizing whatever came to his hands. When he and his fellow residents began refining oil, he began to burn it. Then came his step of progress. He surrounded the flame with a glass chimney.

In so doing he presented to human eye the first steady bright light, except the sun, that it had ever used. Beside this achievement the work of Edison and all other great illuminators is absolutely trivial. All previous lights, fire, the torch, the candle, the open lamp, the gas flame without its modern adjunct, the jet, had been flickering and unsteady, exhausting to the eye and weak. The best of them still survives in a certain antiquated type of lantern with a round, solid wick, giving a wavering light of about one candle-power. Kier's lamp, with its argand burner and chimney, was thirty fold as strong and perfectly steady.

Kier did not invent the chimney. Ami Argand had used it in 1784, and its origin, like that of the steam engine and the theory of evolution and most other vital discoveries, may be traced back till it is lost in obscurity. But Kier put it to its first practical use; he burned in it the new illuminant which alone could make it universal; it became an advertisement for petroleum. People saw it, marveled, desired and from all around Pittsburg came a cry for the oil that made the new light possible.

Note the coincidences on which hung a new epoch in the prosperity of the world. Young comes from Scotland to Boston transferring the center of activity in oil investigation to the country which is to be for decades the world's sole source of oil. The first petroleum is refined in Pittsburg, where Kier is able to avail himself of it. His lamp, again, is displayed in the heart of the oil field so that the demand it creates is certain to be heard and met.

Wherever demand is, not wide enough, but intense enough, supply is inevitable. Statues have been erected to E. L. Drake, who in 1859 drilled the first productive oil well. Drake was an accident. He was a promoter who had been drilling wells for brine and turned to drill them for oil when the demand changed. Greater credit belongs to the man who initiated not the supply but the demand.

A Critical Moment.

In a few years thousands of wells had been bored, and the use of petroleum was spreading in wider and wider circles over the continent. Then came the critical moment in the history of the bright light. In the oil field, oil was the popular illuminant, within every one's reach, but as it went further from Pittsburg the increased cost of transportation made it a luxury for the privileged few. Yet its value to the world depended on its universality of use, its cheapness.

Enter the third figure of our history, John D. Rockefeller of Cleveland. Rockefeller and his great organization made use of the great characteristic of petroleum, its tendency to go through. Its use in the lamp depends on its ability to go through a wick. Polish a glass or metal lamp, fill it, and in half an hour it will be coated with a thin film of oil, which has come through the wick and crept over. Popular superstition declares that it has come through the glass. Put your oil in a barrel, it will come through; put it in a pipe, it will come through. That is what Rockefeller did. He no more built the first pipe line than Kier built the first chimney. But he utilized the idea of making the natural propensity of the oil the basis of a new system of transportation, vaster and more daring than has ever been devised for another commodity. He stretched a wick from the Alleghenies to the sea; he looked through a piece of pipe in Pittsburg and saw New York. Kier built the demand, Rockefeller helped build and finally controlled the supply. Once on the seaboard, transportation by water was cheap. It became possible to sell oil cheaply all over the world; the bright light was within reach of every one.

It was not Fulton, Stephenson, Morse, Lister, Virchow, it was not Mann, Bright, Thiers, Kossuth, Garibaldi, that revolutionized the welfare of the race. It was neither more nor less than this, a bright light within the reach of every one. A light—young; a bright light—Kier and Ferris—within the reach of every one—the pipe line transporters. For with the advent of a bright light, for the first time in history people began to read at night.

Reading Made Universal.

Up to 1859, virtually up to 1875, society was divided into two great classes, clergy and laity, read and unread. The clergy read by day; it was part of their work. The layman had other work by day; at night, with body and brain tired by the day's work and eyes tired by a weak, flickering light, he could read nothing which required concentration; practically, he did not read at all. Reading at night was a feat of phenomenal effort, handed down as the achievement of a few men like Franklin and Lincoln, and doubtless responsible for much of their success. The bright light made reading a universal habit.

Following the abolition of the great class distinction came industrial and commercial revolution. Before the bright light, all trades had been learned by apprenticeship. Theory and practice had been kept separate; the artisan, a mere human machine, had the practice, the professional expert had the theory and often nothing else. There were no technical magazines and almost no technical text books except for the expert. Now there are text books by thousands and periodicals by hundreds for the workers of every trade. Even the hatter and the barber have their trade journals. In a quarter-century learning by book had become a world movement. The artisan studies practice by day and theory by night, learns his trade, often, before he enters the shop, and makes himself an expert before he leaves it. The consequent remarkable development in the quantity and quality of skilled labor has resulted on the one hand in the wonderful industrial progress of the world, and on the other in the rise of the artisan into an independent, intelligent, prosperous class. The merchant, especially the small dealer, has been enabled to keep his books at night, to check up his results, to analyze and order his business, and correspondingly to enlarge and improve it. Commerce, like industry, has become scientific, and thereupon has mastered the world.

Intellectual and social growth is more elusive than industrial and commercial prosperity, if in the last half-century it has been no less evident. Thought may have gained little in intensity; it has gained marvelously in distribution. Fifty years ago it was a commodity as rare as champagne; now it is as common as coffee. Along with the bathtub and the sewing machine, it has become one of the things with which no family can dispense. That abstraction, the "average mind," has leaped into activity and independence. At the same time certain once potent means of education have lost their strength. With Webster and Beecher, oratory was a weapon; it has become an accomplishment. With Keane and Macready the drama was a school; it has become an amusement. There is no doubt as to what has replaced them. Independent of political democracy, intellectual democracy is becoming a world force and dragging social democracy reluctantly after it. Russia in revolt, France shaking off the ecclesiastic yoke, Germany, America, the British Empire peacefully remodeled in communities still political in form, but industrial, agricultural, commercial in essence, all speak the book in the hand of the toiler—the work of the bright light. Fifty years ago public opinion was a figure of speech. Today it holds the tiller of the world. Its origin, like that of other forces, is humble—and odoriferous. The mother of public opinion is kerosene.

Proof? Compare the relative progress of the nations in the last half century, the degree to which they have attained the consummations mentioned—abolition of the clerical class distinction, industrial and commercial development, skilled labor and a prosperous artisan class, independent thought, intellectual democracy, public opinion—with their relative consumption of kerosene.

Progress Due to Oil.

Progress has been swiftest in these United States. We modestly ascribe it to our superior brains. They're not superior. They're neither as capacious nor as well developed as the German variety. Our progress is due to our oil. We had the bright light earlier and more abundantly than Europe and profited accordingly.

France is far behind us. The distinction of clergy and laity still survives. There is a small, highly cultured class, a large, primitive, industrial class, and a peasantry sunk in ignorance. The French make their streets glare with electricity, but they don't light the insides of their houses. They put a heavy import tax on refined oil, because the demand for it at any price is so intense that it makes a beautifully steady source of revenue, and under protection of this tax do their own refining in a perfectly inefficient manner. Consequently there is little or no reading by night. The peasant has choice of going to mass or to bed. The city dweller flees to the one brightly lighted spot, the boulevards. All because cheap kerosene cannot cross the border. "The Man With the Hoe" typifies humanity bereft of the services of kerosene.

Italy and Spain are still further behind, more sharply divided into clergy and laity, with less commerce, less industry, less public opinion. Their progress in the last half century has been greater than in previous ones, but relatively to that of other countries seems trifling. They have poor lamps, poor oil and not much of it. Egypt, Turkey, Syria, Persia have made no progress. Except for the work of Europeans within their borders they have stood still. They have practically no lamps and no oil. So of the rest of the East, save Japan.

Japan, however, has lately developed enormous oil fields in Echigo and elsewhere and buys American and Russian oil in great bulk. The relative development of Japan and China is in exact proportion to their respective importation of oil. Here is proof quantitative as well as qualitative.

Russia, second in production of oil and nearly last in progress seems an exception to the rule. But Russian oil is used principally for fuel. Its proportion of illuminant ingredients is only a third that of American oil, and of this very small fraction four-fifths is exported.

Great Britain, thanks to Young in Glasgow, developed the shale oil industry parallel with the petroleum industry in the United States, and has followed its sister nation, in lighting and progress, as closely as the difference in natural advantages would permit. Germany took to the American lamp and to American oil, promptly and largely. The quality and quantity of American oil imported into Germany and France, as into Japan and China, is an accurate measure of their relative progress.

Later improvements in lighting have not taken, and for a long time cannot take, the place of oil. Gas is available only in cities, electricity is costly. Oil is the light of the uneducated man, by which he becomes a reading citizen. As he achieves emancipation his lamp is replaced, for convenience, not for better light, by gas or electricity. But kerosene is the light of progress. And progress is only beginning. During the last two years the production of oil has increased enormously without meeting the demand; the price has risen as well as the supply. Standard Oil has been driven to another of its remarkable shifts. At this writing, to meet the increased needs of the refineries at Hunter's Point, N. Y., and Bayonne, N. J., oil is being pumped "without change" from the Kansas oil fields, half across the continent. It passes smack through the back yard of the Chicago refinery, the largest in the world. Six months ago engineers believed the feat impossible.

New Methods of Lighting.

Since the introduction of the bright light each of our expositions and one of those abroad has exploited a new method of lighting; a fair indication of the way we have maintained our lead in illumination. The Centennial exposition was characterized by the arc light. The Chicago exposition was lighted with electric incandescents, which replaced the arc for the first time as an outdoor light. Atlanta produced the perfected Welsbach, Nashville the acetylene light. Omaha returned to kerosene with the Kitson light, which burned oil under pressure in a Welsbach mantle. At the Paris exposition appeared the Nernst light, an incandescent without a vacuum, formed by a glowing cylinder of magnesia and zirconia. Buffalo introduced the osmium and Portland the tantalum light, in which the carbon filament of the ordinary incandescent is replaced by a wire of metallic osmium or tantalum. St. Louis showed no new illuminant, but did bring forward radium.

Radium itself is not likely ever to be a direct source of light—its illuminant intensity is much too low—but it served an invaluable purpose in the history of illumination. It made the public for the first time aware of the two warring principles of light, glare and glow. It advertised the idea of illumination by glowing surfaces instead of by glaring points.

In illumination, as in other lines of human activity, there is a kind of progress beside which the contributions of particular men are almost childish, a tide in which individual impulses are no more than waves. This tide radium lifted from the subconsciousness to the consciousness of the public. It revealed the fact that there had been growing, gradually and without recognition a demand for light from radiant surfaces instead of from brilliant points, a rebellion against the intensity of the kerosene flame and the torture of the arc light. Radium kindled this rebellion into open revolt.

Exposition Tests.

The trend of illumination, as well as the invention of new lights, may best be traced through the expositions, the business of which is to inform the public of the latest tendencies of civilization. Mention should be made first, however, of gas, which antedated both expositions and kerosene, a smoky, wavering flame such as you can get by unscrewing the jet from a fixture and holding a match to the open pipe. The jet, by which two fine currents of gas are forced together and flattened into a fan, produced a bright light, as did the chimney, by bringing a greater supply of oxygen in contact with a smaller supply of fuel. But though the jet followed the chimney, its light was inferior. The gas flame is more intense and glaring than the oil flame, and (because even pressure in a gas pipe is impossible) it is not nearly as steady.

The arc lights of the Centennial were a further retrogression. Their intensity was painful; they were all glare and no glow. They emphasized the darkness around them instead of softening it. And their violet tinge aroused a constant protest from the eye. The violet waves are the most perishable of the constituents of light. They are the first to be absorbed by the refracting medium; even glass absorbs them; so does air. Sunlight, which developed the human eye practically without competition until 1850, reaches it shorn of most of its violet rays by the atmosphere—yellowed, so that the eye has a constitutional preference for yellow, and aversion for violet light. The retinal capacity for violet has been weakened by disuse so that we really see less clearly by a violet light than by a yellow light of equal power. Moreover, the violet light of equal power is actually, so to speak, the weaker, for many of its preponderant rays are absorbed by glass and air on their way to the eye, while the yellow reaches the eye intact.

Glow and Glare.

The preference of glow to glare is similarly due to the structure of the eye. Up to 1850 the only offensive light was the direct sun. Whatever she may have done for the eagle, nature shirked her plain duty of adjusting the human eye to direct sunlight; she merely protected it with a lid. And since offensive lights became common, she has taught the eye not to endure but only to dodge them. The same amount of light is more grateful in a broad, evenly distributed glow than in a single brilliant point, for the same reason that a heavier weight is easier to lift with all the muscles of arms, back and legs working together than with one finger. Light from one point is focused to one point in the back of the eye, and the strain of meeting its entire intensity falls upon a single "rod" or "cone" of the retina. The same amount of light from a broad surface is distributed over a wide tract of the retina, no part of which is overstrained.

The only illuminations worthy of the name at the Centennial were the fireworks, which were thought remarkable. Fireworks, alas, have lost their charm. Our children do not love them as we loved them in childhood. More brilliant than ever, they seem less so. The eye, accustomed to the subtle and beautiful illumination achieved in the last decade, finds tawdry the red and blue sparks that once delighted it.

Despite the retrogression from oil to gas, from gas to arc, the instinct of the race, urged by the tortured retina, was already groping its way towards the glowing surface. Those who could afford the most brilliant atrocities of glare reverted again and again to the candelabrum, an aged, smoky, smelly device that yet distributed thirty-candle-power over thirty points instead of gathering them into one. To distribute the light and lessen the glare, gas flames and arc lamps were surrounded with ground glass. The attempt was primitive; it softened the light by weakening it, distributed one-half and absorbed the other; but it expressed the craving for glow years before the advent of the man with whom this craving became conscious.

Edison and Stieringer.

While Edison was perfecting the incandescent light he was doing a greater service for illumination in the training of Luther Stieringer. Like his master, Stieringer was a genius, full of brilliant, daring conceptions; unlike his master, a creative artist, compelled by a keen sense of beauty. Unlike his master, he could not follow out his conceptions into all the details of application, but depended for the execution of his half-shaped schemes on the collaboration of a gifted young executive, Henry Rustin.

Stieringer was called to light the Chicago exposition. No one who saw the illumination of the Court of Honor will forget the impression it made. It was a totally new thing, an achievement of startling progress and promise. The light that the Centennial had concentrated into violet glares was softly distributed in yellow incandescents.

From that time till his death Stieringer lighted all the American expositions, and lit each better than the last. At Atlanta he developed the idea of using water as a reflector, which he had suggested in Chicago, till the lagoons of the exposition were all aglow. And he continued his effort for even, thorough distribution of light, cut down the size of his incandescents and increased their number. At Nashville he weakened them and multiplied them again. Here he conceived the idea of light harmony. He would not allow two kinds of light, of clashing color or discordant intensity, such as the arc and the incandescent, in the same vista.

At Omaha he refined on this idea to the point of refusing to admit two incandescents of different voltage in one vista. And at this point he turned from the method of lighting that had been in use since the first ape-man kindled the first fire to a totally new one. He began to show things, not lights; to do, not lighting, but light-painting. He hid his lights and threw their radiance on the buildings, bringing out their architectural ornament in bold relief, or painting them luminously in broad washes of white and black. At the Philadelphia Export exposition—in 1899, his next effort, he gave up lighting altogether and did nothing but paint buildings with lights.

Then he went to Paris, to see the most artistic of nations light its great exposition in 1900. He turned away in regret. Lighting was not one of the things they do better in France. France, as we noted, was short of kerosene. Its trades were still taught by apprenticeship. Its artists were the foremost, its artisans the hindmost of the world. Its exposition buildings were covered with exquisite mural paintings, and lit with primitive barbarism. Lights of different colors and intensities glared and fought in every vista. The crowning glory of the illumination, the great Chateau d'Eau, reverted to the primitive simplicity of the magic lantern. It was a transparency, lit from within.

Stieringer returned to the Pan-American exposition at Buffalo to teach the world a lesson in lighting. On the shifting fountains he threw subtly blending lights that made the Chateau d'Eau look like the colored bottles in the chemist's window. On the buildings he used lights of four candle power, mere glow-worm sparks, by thousands and thousands, all hidden. The buildings themselves lit the exposition. They rose against the sky, great glowing masses of chiaroscuro—luminous architecture—music not quite frozen.

The Tower of Light was his masterpiece. While its lights were slowly turned on and it became gradually visible in its soft radiance, thousands every night stood rapt, or cheered themselves hoarse, in a spontaneous enthusiasm, a vague delight, that they could not explain. Unconsciously they were expressing the triumph of the new principle, the deliverance of the eye from the bondage of glare.

Then Stieringer died.

Rustin's Ill-Health.

Rustin, worn out by the Pan-American exposition, fled to a milder climate with tuberculosis, and when the St. Louis exposition, with its vastly increased vistas and perspectives, called into existence new problems in lighting, to which the old methods were inadequate, there was no one to meet them. St. Louis lapsed into bright point lighting, and Portland, though its vistas were smaller and some of its details excellent, was not on the whole an advance.

Rated progressively at their glow value, from low value to high, the lights in use today rank about as follows: Acetylene, arc, gas, candle, incandescent, Welsbach, Nernst, oil, osmium, tantalum and Hewitt. The acetylene lights is even more glaring indoors than the arc light outdoors. Gas is handicapped by its unsteadiness. The incandescent is steady, but its light is concentrated in a fine thread. The Welsbach has a large radiant surface, but is hampered by its leaning towards violet and by the unsteadiness of its feed. It varies less than the common gas flame, but perceptibly. The Nernst light has a glowing surface like the Welsbach, but its glow is more intense than most glares. So far it has been bearable only when surrounded with ground glass.

The oil lamp, yellow, steady and fairly soft, is still the supreme reading light in general use, but the osmium and tantalum incandescents threaten its supremacy. The osmium looks like the ordinary incandescent, but uses a much lower voltage and gives a much softer and more economical light. The tantalum light, instead of a simple filament, has a network of wire as fine as 150 spool cotton, strung from little hooks in the bulb. The number of the wires, and their almost invisible fineness, give the effect of a soft glow through a large portion of the bulb. If this apparent glowing surface can be extended, if the wires can be stretched close together from end to end of a two-foot tube, the tantalum light has great possibilities. It is one of the three present lighting principles that give any promise of containing the germ of the light of the future.

The second and best known of these is the Hewitt light. At the moment when Stieringer was reaching his zenith in the Tower of Light, Peter Cooper Hewitt, the gifted son of Abram S. Hewitt of New York, succeeded in making mercury vapor in a sealed glass tube incandescent under the electric current. He did for electricity what the Welsbach did for gas, but to a far greater degree, for his yard or more of soft blue light is the largest and mildest glowing surface yet produced, except by reflection. Its present drawback is its ghastly color. But that this will be overcome is as certain as that petroleum would be produced in bulk when Kier's lamp had appeared. The demand for a mercury vapor light of agreeable color is so intense as to make the supply, sooner or later, and probably sooner, a certainty.

Glow Competitors.

Buffalo, 1901, marked the beginning of what promises to be the great conflict in glow illumination — Hewitt's principle against Stieringer's. It is almost incredible that any direct light should ever be spread as softly over as wide a surface as Stieringer's painted light. And Stieringer's principle has already been applied to interior illumination. The cafe of the Adams house in Boston is lit by a domed ceiling that glows gently and evenly with the reflected light of hundreds of invisible incandescent bulbs hidden around its base. In the great blue dome of the great pillared reading room of Columbia university library—the noblest educational building in the country—hangs what is locally known as "the mothball," a huge globe of ground glass. It is perhaps a hundred feet above the floor, yet at night, when four calcium lights are turned on it, its subdued, reflected radiance fills the whole hall.

These are probably not the only rooms lit (like the philosopher's lamp) by reflection and they certainly do not say the last word for reflected light. The trouble with light-painting is its wastefulness. Like the ground glass around the arc lamp it absorbs half the light in distributing the other half. But the recent investigation and discoveries of radio-active and radio-responsive substances suggest a remedy with which experiments are already being made. Suppose in the future we coat our walls and ceilings with phosphorescent, radio-responsive substances, capable of reflecting, in a modified form, as much light as they receive; barium sulphide, calcium sulphide, Willamite (a radio-responsive silicate of zinc) or any of a hundred others at our hand. In a given case, suppose we select from these the one that will radiate the quality of light most desirable under the special circumstances. Then let us throw on it from hidden recesses that one of the dozen lights at our command from which it can reflect the maximum quantity of the kind of light we desire. Thus, perhaps, we shall ultimately be able to produce at any time a light, the equivalent in strength, quality and distribution, of diffused sunlight; not the light of a gray day, but the light of a fair day with the sun under a fleecy cloud, which, so far as human experience goes, is the perfect light. The miracle of Joshua will be at our command; with the turn of a switch we shall make the sun and moon stand still.