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(Illustrated articles are marked with an asterisk,)

CAUTION.

It has become necessary for us to state very distinctly that the Scientific American Patent Agency Offices are at No 37 PARK ROW, and not at No 39.

ARE OUR COAL FIELDS INEXHAUSTIBLE?

Some sneers were indulged in when, a few months ago, English *savans* debated the question of the exhaustibility of the coal fields of Great Britain, but it might be well even for us, whose area of already discovered coal is seventeen times as great as that of England, to consider the question as applied to us.

A few days ago a gentleman residing in this city informed us that the heating and cooking apparatus of his dwelling had consumed since November last—less than five months—thirty-three tuns of coal. This is no exceptional case; it can be duplicated and even exceeded in hundreds of instances. But the consumption of coal for domestic purposes is as the drop in the bucket compared with the consumption in manufactories, on railroads, and in steamships. If coal is in process of formation now the process is a very slow one. We have no atmosphere of carbonic acid, no forest of gigantic ferns and mosses, no sluggish sea, nor perpetual hot-house summer which might form a coal bed of three feet in thickness in as many weeks, while it would now, under our present circumstances, require 7,400 years to produce a deposit of equal thickness.

The coal beds of Great Britain cover an area, according to Taylor, of 11,859 square miles. Prof. Hitchcock estimates the area at 12,000; other authorities average 7,995, and Prof. Rogers calls it only 5,400. Probably, when the deductions for "faults," "trap dykes," and "worn out" territory are made, about 5,600 square miles will give the present available resources of the English coal fields. Every vertical foot will yield 1,500 tuns of coal to the acre, and 50 feet total thickness will give 75,000 tuns per acre.

Our known coal area is estimated at 206,939 square miles, of which only about 470 square miles is anthracite, yet of 22,000,000 tuns mined in 1864, 10,000,000 were anthracite. When it is considered that the amount mined represented only the current demand, or rather that which was produced for the market, and did not comprise that wasted, lost in pillars, etc., it may excite some inquiry in regard to the ultimate exhaustion of our anthracite beds. The population of the entire East, a portion of the South, and the Northwest, over 12,000,000, draw their supplies from the Pennsylvania anthracite fields, and large quantities are exported to Canada and shipped to other countries. The natural increase of the anthracite coal trade is over two and a half per cent per annum, so in 1870 the demand will be not less than 15,000,000 tuns, probably much more. Estimating an average of sixty vertical feet in thickness our anthracite fields contain 18,000,000,000 tuns, which, at the present rate of increase in demand, would entirely exhaust them in 600 years. But about one half of this is lost and wasted by our present system of mining, and should the anthracite trade ever approach the dimensions of the English coal trade, our supply would melt away in about 180 years.

Some impure anthracite is found in Massachusetts and Rhode Island, and Oregon contains a limited field of the same, but owing to superiority in quality and advantages of location, Pennsylvania will probably continue to be the source from which the nation's supplies will be mainly drawn. While the anthracite of Pennsylvania underlies only 470 square miles of her surface, her bituminous deposits have an area of 12,656 square miles, and all the great Western and the Southern coal fields hold only this hydrocarbon. This will not be used for manufacturing purposes (iron) so long as the nearly pure carbon can be obtained, and will be employed for household and other purposes only when its comparative cheapness offsets its advantages. What the hitherto unexplored regions of the country west of the Mississippi may contain in the way of a mineral fuel, can at present only be conjectured.

PHONOGRAPHY AND PHOTO-PHONOGRAPHY.

The query is not now to be raised for the first time, whether human speech may not be made to record itself. Yet it is in reality a novel question, for we have as yet but vague hints of the possibility, and scarce a hint of the process. Among these hints, the first is the perfectness and definite laws of echo. Since a screen may be erected over against a speaker which will "report" or throw back a *fac simile* of his words, as a likeness is thrown back from a camera—and that by an analogous process, only coarser, *i. e.* the vibrations of a more sensible fluid—why may not the one likeness be embodied and fixed in some way as well as the other? Why may not forces which rebound with such wonderful precision, be brought to make equally precise impressions? Why not a sensitive preparation to be fixed by rays or pulses of sound, as well as of light? If this be attainable, there is evidently no difficulty in securing the reflection of the sounds upon it, in all their perfection and with intensified force.

The difference at once strikes us, that so far as we know, the action of accoustic vibrations is purely mechanical, whereas we have lately discovered that in light there is chemical or actinic power, besides the supposed mechanical action that affects the retina. But how do we know that the sensible effects of luminous and accoustic undulations, or either of them, are of a mechanical and not chemical nature? Who knows that the eye and the ear are not both laboratories, in which a chemical operation is performed in seeing and hearing, as much as in impressing shades upon a sensitive plate? Nay, is it not most probable, that seeing and hearing are or involve chemical processes, equally with tasting and smelling, breathing and muscular action? And if so, is there not probably some means of imitating the process and fixing its results in the case of hearing as of seeing?

Again, an apparent difference between the actual and the supposed art is that the one must in some way be bridged over into the other: the latter is complex, and includes both the former and some *nexus* between them which is precisely the undiscovered element in the problem. But this is perhaps only a *prima facie* necessity, and thus the inquiry here branches off in two directions; on the one hand in quest of a point of contact between accoustic operations and visible phenomena, through which audible undulations may register their effects in visible symbols; and on the other, of a way for the accoustic impulses to be impressed upon secondary agents which shall give them back as the negative does, when properly called for and not otherwise.

If the latter were possible, a reciprocating pair of such agents, properly re-inforced in energy, could maintain the impulses and propagate copies of them *ad infinitum*, and thus the speech of an orator would be handed down to all time and all mankind exactly as it sounded from the lips. All books worth reading *verbatim* would be read to the phonograph by elocutionary experts, and thenceforth read by the phonograph to the hearing (not reading) public, who would thus be saved the labor of reading, and perhaps the art itself would go out of fashion. But it is hardly worth while to anticipate just now all that might be hatched out of such an egg as that. Less extravagantly, we may surmise that an arbitrary language of phonic symbols might be constructed in which dumb things could be made to utter a translatable echo of human speech.

There are some advantages obvious to phonography proper, compared with photography, as original questions. There is the wonderful ubiquity and uniformity of the accoustic undulations, precisely the same to an infinite number of hearers in an infinite variety of positions; whereas the undulations of light are confined to right lines of movement, and no one of them can impress more than a single objective point. There seems no more intrinsic difficulty in concentrating and intensifying the accoustic than the optical undulations, and if this were to become practicable, (by the aid, perhaps, of some imitation of the tympanum) it would follow that a system of accoustic reflectors and conductors could carry human speech not only to indefinite distances but to innumerable auditors. Practical attempts in the distant transmission of the voice are now going on in France, as our readers are aware. But leaving this aside, the fact that an accoustic wave takes effect in all directions and at all points, greatly facilitates the attempt to fix its effect. For, suppose a mechanical or chemical appliance to be invented, so delicately adapted that an individual accoustic wave would in some way make its characteristic mark. Let such sensitive points be brought into exposure and withdrawn in succession as rapid as the contractions of the stylo-glossus in speaking. Or let a surface of this character be covered with a moving protector having a single perforation which should traverse the whole in regular lines, at the proper speed. Every wave would infallibly find its proper objective point and make its mark in its proper order, and the intervals of sound between letters, words and sentences, would be shown with absolute precision by the unmarked spaces, as in print.

The sensitiveness of flames to the accoustic vibrations, on which we had experiments so interesting from Prof. Tyndall, of late, suggests the possible application of gases, incandescent or otherwise, for registering sounds in a variety of ways. Flames would be most naturally expected to register photographically; but they have also calorific, mechanical and chemical effects adaptable to the same purpose. Thus there are four distinct modes in which effects can undoubtedly be transmitted through flames from the sounds of the voice. If it be practicable to find adjustments of flame which shall respond distinctively to each vocal sound and interruption, and with corresponding rapidity, it would seem much easier to register those responses in some of the various modes that already suggest themselves.

Other conjectures might be made, but we have said enough to stimulate thought and inquiry upon the subject; and as that is all we had in view in setting out with these cursory speculations, they may be dropped at this point as well as at another.

THE DANGERS OF OUR ARTIFICIAL LIGHTS.

It is becoming a matter demanding serious inquiry and possibly legislative interference what shall be done to prevent the accidents so commonly occurring from the use of the common means for producing artificial light, or, at least, to diminish the danger. If a correct record could be presented of the catastrophes—the injuries to person and property—which have been caused by the use of gas, kerosene, camphene, and burning fluid the statistics would appal the reader.

Gas explosions are always the result of carelessness or thoughtlessness. It is probably the least dangerous agent for producing light since the relinquishment of whale and lard oil for this purpose, but the ignorance or the thoughtlessness of people make it sometimes a very dangerous substance. Confined in pipes it is perfectly safe. It cannot explode nor even burn until mixed with the oxygen of the atmosphere, and it has the valuable quality of denoting its presence when mingled with the air we breathe. In this form it is dangerous, yet when a meter or the pipes located in a vault or dark cellar leak, it is too common a practice to enter the room with a light to examine the leak, when of course an explosion takes place. This can be readily prevented by first ventilating the room through doors and windows. There can be no excuse for these accidents nor for the blowing out of a gas light leaving the pipe open for the escape of the gas, a trick usually ascribed to country visitors to cities, but not seldom performed by those who should know better. Cases of death by asphyxia in sleeping rooms from this inexcusable carelessness are not unfrequent.

Camphene and burning fluid have been largely superseded by kerosene, yet they are still used to a limited extent, the fluid being burned by a wick in the ordinary manner or used to generate a gas in the lamp itself. In whatever manner employed these mixtures of alcohol and turpentine are dangerous, as many fatal accidents have proved. We know of no method of preventing the danger attending their use, and are glad they are going out of fashion. But it may be doubted whether in exchanging them for kerosene we are not "jumping from the frying pan into the fire."

Kerosene accidents are altogether too common. It would seem that this hydro-carbon might be made at least non-explosive; that it can be made non-inflammable is impossible without destroying its light-producing qualities. But many serious and fatal accidents are continually occurring by explosions of kerosene lamps. A low distillation of the oil would easily remove the more etherial substances in its composition, which, at temperatures not excessive, generate an explosive gas. There should be some simple means of testing kerosene to detect the presence of these volatile elements. Beyond that, only care in the use of kerosene promises to avert its dangers.

It is commonly burned in glass lamps. Now glass is one of the most unreliable substances known, and if not properly annealed will sometimes, even when untouched, fall in pieces as though shattered by a blow. Very likely many of the so-called explosions of kerosene lamps occur by the fracture of the glass lamp containing the oil. An eminent chemist tells us that a few days ago a glass bottle which he had used for years, and which contained collodion, suddenly shivered into fragments while standing on a table where it had remained untouched for weeks, and a flask that he had used for distilling benzine broke in a similar manner after it was laid aside.

The practice of blowing out the light when the flame is full, by throwing the breath down the chimney is pernicious. If the wick is loose in the tube the flame may be forced into the lamp and instantly ignite the surface gas or the oil itself. A better practice is to turn the flame down to a flicker and then blow it out. Lamps of metal would seem to be preferable to those made of so treacherous a material as glass, although they are not so elegant.

It is hardly credible that manufacturers or venders of kerosene would willing deal in a dangerous article containing explosive elements, as their reputation and consequent profits depend upon the quality of the fluid, but the presence of naphtha and benzine in much of it now sold is susceptible of proof. Legislative interference, aided by science, appears to be demanded as a protection to consumers; for it cannot be expected that the people at large are to become analytical chemists in order to judge of the quality of the oil they use. Either this, or we must go back to the use of the old fashioned oil lamp, the breaking of which is attended with no more serious consequences than the formation of a grease spot.

OUR STREET PAVEMENTS.

In our issue of April 13th, we spoke somewhat in favor of the Nicolson pavement, our opinion being founded on the reports of its trial in Chicago. We have received several communications in relation to the subject, our correspondents being much gratified with our expression of opinion. A resident of this city says that the substitution of wood for stone, or the London Mc Adam for our cobble and Belgium pavements, is demanded on the score of mercy to the horse. He asserts that the number of horses permanently injured by our