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(Illustrated articles are marked with an asterisk.)





## THE MANUFACTURE OF ILLUMINATING GAS.

There have been very few changes in the manufacture of illuminating gas since the time that Westminster bridge and Pall Mall were lighted by it about sixty years ago, or since the organization of the New York Gas Light Company, within the memory of many men now living in our city. The original drawings of retorts, scrubbers, and purifiers, as given in the old work of Accum and Aiken, could be made to serve as guides to the constructing engineers of the present day. But the real progress has been in the grand discoveries of the uses to which the incidental products of the distillation of coal are capable. Our chemists appear to have overlooked the direct product, the illuminating gas itself, and to have devoted all of their energies to a study of the properties and uses of coal tar.

This state of things is now fast changing, and, recently, important progress has been made in the manufacture of illuminating gas, so that it is probable that the crude and unscientific method of distilling coal handed down to us by those who first undertook the manufacture, will be entirely dispensed with, and bituminous coal will be distilled for benzole, anthracene, paraffine, and oil, but not for gas.

Nearly one half of ordinary illuminating gas is composed of hydrogen, which, as is well known, burns without any illuminating power whatever. It is also known, that perfectly pure hydrogen can be prepared by passing illuminating gas over lime heated to cherry redness, the dry residue being carbonate of lime. From recent researches, it would appear that a somewhat similar decomposition of the hydrocarbon generated by the distillation of coal takes place in the retorts, carbonic acid, carbonic oxide, and pure carbon, in the form of gas carbon, and coke resulting.

What the gas company wants is, not hydrogen, but a suitable compound of that gas with carbon; but, in spite of all the precautions of the engineers, half of the product of the manufacture is hydrogen. Since the discovery of this fact, attention has been directed to cheaper methods for the preparation of hydrogen, and the subsequent carbonization of that gas in an economical way, thus securing a gas entirely composed of hydrocarbons of great illuminating power. This carbonization can be accomplished in various ways, and we may recur to some of them subsequently.

The method for the manufacture of pure hydrogen that appears to be the most practical, at the present time, is the one proposed by M. Tessie du Motay, and consists in heating a mixture of damp coals and hydrates of the alkalies. A mixture of hydrogen and carbonic acid is thus generated, which can be freed from the latter gas by being passed over other alkalies, which, being thus converted into bicarbonates, can be sold as such, or can be used as sources of pure carbonic acid now extensively required in the arts. The alkalies originally employed can be regenerated, to a considerable extent, and used over again. The hydrogen comes from the water of hydration of the alkalies, and from the moist coal, and the carbon serves as a reducing agent, to give us a pure gas. It is said that hydrogen is more economically made in this way than in any other. The cost of carbonizing it by passing it through benzole, or by synthetical methods, is trifling, and, in theory, at least, we here have a simple and cheap method for the manufacture of illuminating gas, without the necessity of vast retort houses, exhausters, purifiers, condensers, and incidental products of the ancient distillation process. In connection with this method of making hydrogen, and converting it into hydrocarbon, we have the proposition to add oxygen at the point of combustion, but this proposition brings up other questions that it is not necessary for us to discuss in this article.

Since the introduction of petroleum into commerce, attention has been naturally turned to it, and to its products, as a probable cheap source for illuminating gas. Various patents have been taken out, and a number of hotels and small towns in the country are using gas manufactured under one or another of them.

When petroleum is distilled, one of the first products that goes over is a highly explosive and volatile compound called naphtha. It would be entirely a waste product, were it not for the fatal and highly reprehensible habit, on the part of some dealers to adulterate and increase the volume of kerosene by its use. In naphtha we have an admirable material for the cheap production of illuminating gas. To prevent danger from fire, the naphtha is converted into a vapor by steam, and it is afterwards superheated and then passed into retorts, where it becomes a fixed gas. It is then conducted into suitable gas holders. As it is free from sulphur, carbonic acid, carbonic oxide, and other impurities, the necessity for purifiers, and other expensive machinery is dispensed with. The gas prepared in this way is free from the volatile and condensable products of the distillation of coal, and hence, is not affected by cold weather, and is not liable to clog the pipes. The manufacture can be conducted very nearly automatically, so that very little labor will be found to be necessary. The heat required is small, and the yield of gas very large for each retort. When tar, dead oil, and other hydrocarbon liquids are used, greater heat and more complicated machinery are necessary; and such material is itself often the product of the distillation of coal, and therefore does not enable us to dispense with the old methods of making gas.

The progress of science, during the last ten years, also points to the probability of our making illuminating gas synthetically But such a realization is too distant for us to do more than allude to it as within the range of possibility. What we particularly need, is an invention that will enable us to dispense with the present crude way of making gas, which creates a nuisance in the city and affords an article of very inferior illuminating power.

It would not appear to be a difficult matter to accomplish this result, and, as we have pointed out in our article, there are a number of methods that have such elements of success in them, that they ought to be thoroughly tested before being abandoned as worthless. But whatever is done, we hope that the streets of our city are not to be dug up for the laying down of pipes, and to give certain people jobs, before the proposed improvement in gas has been fully tested. We have witnessed enough pipe-laying in our day, and have suffered sufficiently from expenditures of gas to be willing to wait until the proposed change is certain to be an improvement, before asking to have it tried.

## COATING VESSELS WITH ZINC.

The protection of iron ships by the application of zinc, or, in other words, the galvanizing of their surfaces, has attracted considerable attention. The process of "galvanizing," as it is called, that is, the coating of iron with zinc, is ordinarily performed by dipping the piece to be galvanized into melted zinc, the piece being previously cleansed from oxide and dirt, and the surface of the melted zinc being covered with sal ammoniac.

Taking this brief description of the process as a starting point, it seems a bold proposition to galvanize a large iron vessel. Yet this is just what is proposed by Mr. Charles Lamport, who, in an address before the Institution of Naval Architects, at London, at a recent session, gave the details of his plan.

Before we notice these details, however, it will be necessary to notice the difficulties which render them needful.

The first of these is the removal of the peculiar skin, or scale, which is met with on all iron plates, as they come from the rolls, and which prevents the adhesion of the zinc. It is also necessary that the plates should be brought to a temperature nearly equal to that of the melted zinc.

It seems, that of late, on the European continent, a method of pouring the zinc over the plates, instead of immersing them, has been rendered possible and successful, by the use of a flux, the nature of which is not given in the address of Mr. Lamport—a very important omission indeed, as he seems to rely upon its use in the application of his method, which is as follows:

Over the sides of the ship he will suspend a bath with so much of a furnace attached as will maintain the zinc in a fluid state. This bath being in contact with the side of the ship, the plate against which it is placed will become of a temperature, he thinks, sufficient to allow of adhesion, if the scale be taken off.

To remove the scale, as well as to perform the other parts of the operation, he proposes to use what he styles molds, one of which will be made of a steel plate one fourth of an inch in thickness, rolled cold, and having a very fine skin put upon it, so as to prevent the adhesion of the zinc to it. Around the edges of this plate will be found a thin edging of metal of the thickness of zinc plate desired to be cast on the side of the ship. Preparatory to the application of this mold, the scale is to be removed by the use of a wooden mold, coated with some substance that will resist the action of sulphuric acid. Between this mold and the side of the vessel the acid is to be introduced and allowed to remain long enough to remove the scale. The flux is to be applied in a similar manner, after which the melting furnace and steel mold, above described, are to be applied, provision being made for its exact accordance with the space previously acted upon by the acid and flux. The melted zinc is then to be poured into this mold and allowed to run through until such time as the iron is heated to the proper temperature for adhesion, when the flow will be stopped and the plate will become permanently attached to the metal. At least, that is the opinion of the inventor of the method. Whether he is right or not will appear from the practical experiments he intends to perform during the ensuing year.

Provision for buckling is to be made by allowing portions of the zinc to remain unattached to the iron, a matter regulated, of course by the non-removal of the scale, except of such parts as are desired to unite with the zinc.

Of course it would be unwise to hazard any positive prediction as to the ultimate success or failure of this method, in anticipation of its practical trial. We cannot fail to see, however, numerous practical difficulties, which will heavily tax the genius of Mr. Lamport to overcome. We shall keep watch of any reports of experiments made in this direction, and, if important results are attained, will lay them before our readers in due time.

## THE NEW PATENT LAWS---IMPORTANT CHANGES AFFECTING AMERICAN AND FOREIGN MANUFACTURERS---FREE TRADE IN PATENTS NOW FULLY ESTABLISHED.

The advocates of the free trade system, if they did not succeed at the late session of Congress in realizing all their aims, certainly made a clean sweep so far as patents are concerned.

This country is now thrown freely open to all foreigners in respect to patents, and the peoples of all countries may come or send here and compete with American genius and industry on the most favorable terms.

The law which required foreigners to put and continue their inventions on sale in this country, within eighteen months after obtaining their patents, has been repealed, and foreigners, like our citizens, may choose their own time for working their patents.

Another provision of the new law permits a foreigner to patent his invention here at any time, even after it has been introduced and patented abroad for years, provided it has not been used here for more than two years prior to application for an American patent.

The old law prohibited the grant of a patent for any foreign invention that had been brought into use here, even for a day, prior to application for a patent.

In the same way the new law also throws open to foreigners the right to take out patents for designs, and as this virtually includes all the new figures and pattern for every description of fibrous and textile goods, such as carpets, silks, laces, calicoes, trimmings, etc., the law becomes important to our home manufacturers.

The following is the provision of the new statute in relation to design patterns:

"Any person who, by his own industry, genius, efforts, and expense, has invented or produced any new and original design for a manufacture, bust, statue, alto-relievo, or bas-relief; any new and original design for the printing of woolen, silk, cotton, or other fabrics; any new and original impression, ornament, pattern, print, or picture, to be printed, painted, cast, or otherwise placed on or worked into any article of manufacture; or any new, useful, and original shape or configuration of any article of manufacture, the same not having been known or used by others before his invention or production thereof, and patented or described in any printed publication, may, upon payment of the duty required by law, and other due proceedings had the same as in cases of inventions or discoveries, obtain a patent therefor."

The Government fee for a design patent is $10 for 3½ years, $15 for 7 years, and $30 for 14 years, with privileges for extension.

Another novel provision of the new law consists in the registration of trade-marks. When a patent has been granted for the article or the pattern, a further security may be obtained in the shape of a patent upon the trade-mark that is placed upon the article or goods. The following is the law for trade marks:

"Any person or firm domiciled in the United States, and any corporation created by the authority of the United States, or of any state or territory thereof, and any person, firm, or corporation resident of or located in any foreign country which by treaty or convention affords similar privileges to citizens of the United States, and who are entitled to the exclusive use of any lawful trade-mark, or who intend to adopt and use any trade-mark for exclusive use within the United States, may obtain protection for such lawful trade-mark, by complying with the following requirements, to wit:"

The Government fee for registration of a trade-mark is $25. Duration 30 years, with privilege of renewal.

One effect of the above new laws will be to put an end to that extensive class of American industries which has grown up and flourished by the manufacture of articles and goods copied from foreign sources. All who undertake such reproductions without consent of the foreign originator, will be liable to be interfered with at any time, by the grant of a patent, and the stoppage of their works.

Another effect of these laws will be to compel our citizens to invent their own designs, and thereby artistic invention on our own soil will perhaps be encouraged.

We have in preparation, to be issued in a few days, a new

edition of our widely-known instruction book. It will contain the new patent laws, with full directions for those who wish to avail themselves of its benefits. We shall be happy to forward copies of this book *gratis* to all who will send us their names with the stamps to pay the postage—four cents.

Meantime, Messrs. Munn & Co. would inform their friends in all parts of the world, that they are in readiness to take out patents for inventions, designs, and trade-marks, under the new laws, with promptness, and on moderate terms.

Address Munn & Co., 37 Park Row, SCIENTIFIC AMERICAN Office, New York.

## HOW MERCURIAL THERMOMETERS ARE MADE.

The word thermometer,as everybody knows,of course,means "heat measurer," and yet the word, in its etymological signification, conveys what is, or, at least, may be, an erroneous notion of the actual results obtained by means of this useful and interesting little instrument. That heat should be accurately measured, implies that we should be able to start from zero, or no heat. The zero upon our ordinary Fahrenheit thermometers is only thirty-two degrees below the freezing point of water, and this temperature,as is demonstrated by the use of instruments capable of indicating a relatively very low degree,is still as evidently heat,and a good deal of heat,though not so much as that of our scorching July days. We have no more authority for saying that the lowest degree registered closely approaches the lowest, in the nature of things possible, than we have for asserting, that the highest degree attained or measured is the highest degree possible. All that the thermometer does, is, assuming that the cause is proportional to the effect, to indicate by a regularly adjusted scale, the expansion and contraction of a certain substance—for instance, alcohol or mercury—and from this expansion and contraction, we infer that the cause or condition of it—that is,the increase or decrease of heat is proportional to the result. It would not be erroneous to say, that the thermometer measures the relative increase or decrease of temperature, but it does not, and can not, measure heat itself. Yet the uses of the instrument are as various and beneficial as if heat were as absolutely measured, as we can measure the pressure of the air by the barometer, or the specific gravities of liquids by means of the hydrometer. All results,dependent exclusively upon heat, will be uniform, for the same degree of heat, and, using this law, we can reason from one result to another, the results, of course, having been first obtained by experiment, and registered for use.

As an illustration, having once discovered and noted the fact, that water boils in the open air when the mercury of a thermometer, immersed in it, has expanded to the point of 212° on the scale, we may always count on the concomitance of these results, the boiling of water, and the registered expansion of the mercury, except under the following circumstances, which, so far as we know, have yet received no explanation. After a thermometer has been exposed for some weeks to the ordinary temperature of the air, if it be suddenly exposed to the temperature of boiling water, its freezing point will often be found to have lowered from one to two degrees. This has been observed in some of the standard thermometers of the Royal Society, London, and by various experimenters. It is sometimes two or three weeks before the freezing point corresponds again with that on the scale.

The determination of the temperature at which different physical results take place is of incalculable advantage to science and the arts, notwithstanding what has already been said, that the thermometer really does not measure heat at all.

It is not intended to discuss here, however, either the history, theory, or uses of the thermometer. Our object is to describe the manufacture of the instrument, the indications of which have so much to do with our physical comfort or discomfort, and which are so important to nearly all processes in the arts.

A mercurial thermometer is a very simple instrument. A small glass tube, with a bulb at one end, containing mercury, and a graduated scale, constitute all that is essential to it, yet in this, as in many other cases, simplicity begets difficulty. To make this simple combination perform its duty accurately, is by no means an easy matter. The first difficulty met with, is the want of uniformity in the diameters of the bores of different tubes,and the varying size of the bore in almost every tube. It is scarcely possible ever to find one the caliber of which is the same throughout its length, and,if so found,it is the result of pure accident. It is obvious, therefore, that unless some means of eliminating the errors which would arise from this source, be adopted, nothing like accuracy can be expected in the indications of the instrument. As the character of the bore cannot be altered, the desired result must be obtained in another way.

The method employed to obviate this difficulty is called "calibration." Tubes are selected tolerably free from imperfections,and a column of mercury,of one inch or less in length is introduced into it. The tube is then attached to the frame of a dividing engine, and put in connection with flexible rubber bags, to which pressure is applied, and regulated by screws. The air pressure in one bag being reduced, while it is increased in the other, the mercury column may be forced to and held at anypart of the tube.

The mercury being thus brought to the portion of the tube where the graduation is proposed to commence,the exact position of one end of the column is marked upon the tube, a microscope with cross wires being employed to aid the eye of the operator in performing the operation with exactness. By means of the rubber bags, the mercury is again forced along until the end of the column, where the first mark is made, is brought under the microscope cross wires, placed at the other end, and so on throughout the entire length intended to be graduated. The varying lengths of the column which are accurately measured in the different positions are recorded,and indicate the variations in the caliber of the tubes. A permanent mark is made at the end, as at the beginning of the calibration.

It will be seen, that if the spaces successively occupied by the mercury be divided into an equal number of equal parts, anyone of these parts will indicate a corresponding increase of volume, although the bore of the tube may vary in its diameter.

The required dimensions of the bulb are found, aproximately, by weighing a measured length of the mercurial column, and computing the capacity of the bulb from the known expansion of mercury and its specific gravity.

The bulb may be formed upon the tube previous to the calibration, or afterwards attached. In the former case, however, the thermometers have their scale divided after the determination of the freezing and boiling points, and no tubes can be used except such as are found to be approximately perfect. In the latter case, the arbitrary scale, as marked from the calibration, may be reduced after the determination of the freezing and boiling points into the Fahrenheit scale, by the application of a simple algebraic formula.

The freezing point is determined by placing the bulb in finely pounded ice, from which the water is drained away as it melts. The boiling point is obtained by placing the bulb in steam having the same elasticity as the atmosphere, a peculiar apparatus, devised by Regnault, being generally employed for the purpose.

In putting in the mercury, a small reservoir of paper or glass is fixed upon the upper end of the tube. Heat is then applied to the bulb, which, driving out the air through the mercury, the latter, as soon as the bulb is allowed to cool, descends through the tube, being forced by the pressure of the external atmosphere. The upper end of the tube is then heated and drawn out, ready to be sealed hermetically. The mercury is then boiled in the bulb, to expel all trace of air, and, while it is in a state of ebullition, the tube is sealed by directing the flame of a blowpipe against the upper end,which fuses the glass and closes the aperture.

The reader must not imagine that all the manipulations we have described are performed on all thermometers in a perfect and accurate manner. A very large majority of these instruments, in common use, are entirely worthless for any scientific investigation, although they furnish, perhaps, sufficiently accurate indications for the regulation of the temperature of apartments, and for other ordinary purposes.

## IS THE KNOWLEDGE OF ENGLISH GRAMMAR NECESSARY TO THE WRITING OF GOOD ENGLISH?

A correspondent writes us that the practical working men of this country need a practical grammar in order to enable them to attain that facility and accuracy of expression, essential to a lucid communication of their ideas. The present works upon the subject, he thinks, are overburdened with rules, observations, and quotations, and are not adapted to the use of such as wish to learn to write and speak correctly in the shortest possible time, and without the aid of a living teacher.

As this bugbear of grammar is, we know, preventing many valuable ideas and suggestions from receiving the publicity they deserve, we propose to devote a brief space to its demolition.

First, then, we say that the use of correct and forcible language, either in writing or speaking, is purely a matter of habit. No one in writing can afford to stop and apply grammatical rules to every word and phrase he employs, and no writer does this. If he had these rules all at his tongue's end, they would not enable him to use good language, unless good language is the daily habit of his life. Many of these rules are of extremely doubtful character, so far as the English language is concerned, and more are so loaded down with exceptions that they are practically useful only to critics in defining and pointing out errors of style and construction in such literary productions as depend for their merit more upon their style than anything else. The use of good language cannot be put on and off like a coat. He who accustoms himself to loose forms of expression to-day will to-morrow speak loosely when he perhaps desires to be accurate.

Many of our most able writers and speakers know little or nothing of grammar as a science, and one of the most forcible writers among the contributors to our present magazine literature has recently written a series of articles for the *Galaxy*, in which he has sought to prove that most of the definitions and so-called rules of English grammar are shams; even going so far as to entitle one of his articles "The Grammarless Tongue," meaning by the expression, grammarless tongue, our vernacular. It must be confessed, too, that he made out a pretty strong case.

If, then, the use of good English is not to be learned from "English grammars," how is it to be learned? We answer, by familiarizing ourselves with good language, by studying the meaning and derivation of words, by the habitual reading of such authors as are accepted authorities in the use of language, and whose writings have established its usage. This will not avail, however, if an attempt is not made to shake off bad habits, and acquire good ones.

But it is not necessary to possess the most happy style of expression to communicate important facts. An old professor used to remark that most people of moderate education can write and speak forcibly if they *have something to say*, meaning that they must possess some complete idea, well thought out, before they attempt to utter it. A man having an idea thus mentally wrought out, may misplace capitals and misspell words, but he can scarcely fail to make himself understood; for his thinking has been done in language, and the natural expression of the idea must be nearly or quite as clear as his thinking. But if he try to assume an artificial style quite foreign to that which he is accustomed to use, ten to one he will fail to make himself understood.

We trust no correspondent or reader will hesitate to communicate anything he deems of value to us for fear of making grammatical or orthographical errors. Let the aim be merely to express the ideas clearly, and we will be responsible for all the rest.

## DEPRECIATION OF AMERICAN VITALITY.

Dear reader, during this terribly exhausting devitalizing weather, we have steadily kept to a pre-adopted resolution that we would leave the discussion of the "heated term" entirely to the dailies and health journals; and, although the above heading might at first sight lead to the belief that our stock of subjects is so far exhausted that we are compelled to resort to a rehearsal of the oft-repeated platitudes which annually appear at this season, about the heat, and the dust, and the way to avoid sun-stroke, and how to keep cool, and how to get a good sleep in hot weather, etc., etc.; we assure you that we have something more weighty to discuss.

We Americans are charged with a "decrease in vitality;" not at this particular season, but in general. We plead "not guilty to the charge."

What is the evidence of our decreasing vitality? The report of a life insurance company, which shows that out of forty-four deaths occurring during the past year among its insured, eighteen had been insured only three years.

This a cotemporary takes as ample evidence of the decrease of "American vitality," and gives us a column-and-a-half homily upon our sins of omission and commission, which in its opinion are fast bringing the nation into a state of physical degradation.

In defense of our plea, we call attention to the following facts. First, that the present competition among life insurance companies, and the methods in which many of them transact business, are such that we wonder the proportion of deaths occurring among their insured is not greater than it is. Second, the fact that we, as a people, bear and endure more than formerly, is an evidence of increasing rather than decreasing vitality.

Only consider for a moment the burdens of dress which our increasing civilization imposes. Think of the bunion-breeding boots, the chest-compressing corsets, the fashionable, black silk, headachy hats for males, and the almost entire absence of hat for females. Think of the horrible heaps of hair bundled upon the heads of our women, and the merciless exposure of the necks and legs of American children.

Think of the indiscriminate way in which we bolt our food at all hours, and how that food is adulterated, and how abominably it is cooked. Think of the gallons of tepid enervating drinks we swallow, and the annual consumption of alcohol and tobacco.

Think of the system of tasking and cramming from books, which we call education, and how our daughters graduating at eighteen from seminaries of learning, are expected to have mastered, or done their best to master, all the dead and living languages, the sciences, literature, and metaphysics.

Think of what frightful drafts upon the hours of natural rest are made by the balls, routs, and parties of fashionable society.

Think of how our young men plunge either up to the neck in dissipation, or rush without stint into business in the mad race for riches.

Think of how all this rush and bustle, this highly seasoned mental and bodily food feeds the passions, and begets a craving for the excitement which in turn, instead of satisfying, feeds the craving.

Think of our swift journeys by land and sea. Think how the telegraph brings all countries near, and how events, the news of which thirty years since would have scarce reached us in months, are now retailed by the news mongers next morning before we get down to breakfast, demanding increased activity of brain, and keeping the mind constantly at work.

It is safe to say that an average American of to-day lives more in one year than he could have done in ten, a half century ago.

And yet he stands it pretty well. To be sure, his nerves are rather sensitive, and he finds it hard to sit still. You will nearly always see him dancing his cane, or drumming on the table, twitching his legs, whistling, or humming a tune. But even these additional drafts upon his vitality are honored by his constitution in a way that shows that although he may, and often does overdraw the account, that account must be a large one at the outset of his career.

No! American lives may be shorter than formerly, although we think there is not good evidence of even this; but vitality must be on the increase, or the drains made upon it would make us all bankrupt.

We rest our case. What say you, gentlemen of the jury?

## SCIENTIFIC INTELLIGENCE.

### CURE FOR LEAD POISONING.

In some of the large establishments of France the best antidote for lead poisoning was found to be a lemonade made of weak sulphuric acid, but after a while the workmen became disgusted with the taste of this liquor, and refused to drink it. It was observed that two workmen in one of the factories were entirely exempt from lead colic, and, upon inquiry, it transpired that they made free use of milk. The director of