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(Illustrated articles are marked with an asterisk.)

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THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 286,

For the Week ending June 25, 1881.

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PRINTING INK.

A few years ago the preparation of printing ink was considered a part of the printer's trade; now there are very few printers who have more than a remote idea as to the composition or preparation of the inks they use.

The manufacture of such inks has of late years developed into a distinct industry, employing hundreds of thousands of dollars capital, and turning out hundreds of tons of ink annually.

The basis of all ordinary printing inks, from the cheap poster and news to the finer lithographic and plate inks, is a varnish, prepared from oils, chiefly linseed, although nut oil is sometimes used, and rosin oil frequently introduced in the cheaper grades.

Where linseed oil is used this *varnish* is practically anhydride of linoleic acid, the fatty constituents of the oil—glycerine, palmatine, etc.—having been volatilized by heat. For the better class of inks old oil is preferred. It is usually purified by heating it for several hours by injected steam or otherwise, with oil of vitriol (sulphuric acid) diluted with about three times its weight of water. The acid solution having been drawn off the oil is washed by agitation with boiling water, and, after standing to allow the latter to separate, is run off into storing vessels. From these the oil is transferred to iron caldrons provided with stirring apparatus and covers. A moderate fire in a small furnace beneath gradually heats the oil, which only half fills the vessel (to prevent accident by foaming) and the stirring apparatus is set in motion. The moisture in the oil is gradually dissipated, and as the temperature approaches 570° Fah., an inflammable vapor or smoke begins to escape from the boiling oil; a scrap of burning paper secured in the cleft of a long stick is thrust into the smoke, which is thereby ignited. The fire below is drawn and smothered; the oil, or rather the gases given off by the oil, are allowed to blaze, the combustion being kept within bounds by partly covering the pot if necessary. Samples of the oil are taken out from time to time and tested by cooling a few drops on a plate of glass or tile. When the drops thus chilled glaze over quickly and draw out into strings of about half an inch between the fingers, the flame is extinguished by putting the cover tightly over the pot. The oil is then again heated over a moderate fire to the boiling point, and the heat and stirring kept up for several hours, small quantities of drier being introduced by some manufacturers.

Varnishes of several degrees of thickness—from greater or less boiling—are prepared in this way to satisfy the requirements of the different kinds or grades of ink, and to modify their consistence to suit the climate where used, thinner ink being required in cold than in warm climates.

For black letter-press ink the color and character are usually imparted to the varnish by the incorporation with it of lampblack or carbon black, Prussian blue, indigo, resin, and soap. The proportion of these vary according to the purpose for which the ink is intended. The following will serve as an illustration of the composition of a good letter-press ink: Varnish (prepared as above), 1 gallon; resin, 4 pounds; brown resin soap, 1¼ pounds; purified lampblack, 5 pounds; Prussian blue and indigo, each 1¾ ounces.

In compounding the ink the resin is finely powdered and gradually stirred into the varnish, made hot enough to melt and dissolve it. The soap, previously cut into thin slices, dried, and rubbed into fine crumbs, is next introduced, a very little at a time, as the moisture it still retains is apt to occasion a violent commotion as it is driven out by contact with the hot varnish. The addition of soap to printing ink increases the sharpness of the print and tends to prevent smearing or clouding of the work. The mixture, after cooling somewhat, is poured over the lampblack, and finely powdered blue pigments placed in the bottom of a suitable vessel, and the whole is well stirred together and then ground in a paint mill until reduced to a very fine, smooth, and uniform paste.

The quality of such inks depends largely upon the thoroughness with which the pigments are incorporated with the paste by grinding.

Lithographic inks are simply very fine printing inks made somewhat more fluid than required for letter-press or cut work. The ink used for engraved or plate work is usually a heavy printing ink made with ivory black, or ivory and carbon blacks, instead of lampblack.

Colored printing inks are made from fine, clear linseed oil, boiled into a varnish as above described, and appropriate pigments. The pigments used are carmine, lakes, vermilion, red lead, Indian and Venetian reds, chrome yellow, chrome orange or red sienna, gallstone, Roman and yellow ochers, verdigris, indigo, Prussian blue, Antwerp blue, ultramarine, luster, umber, sepia, and various mixtures of these.

A very fine printing ink may be prepared without burning, and the risks attending boiling oil may be avoided, by using the following receipt: Balsam of capivi, 9 ounces; resin soap, dry, 3 ounces; lampblack, purified, 3 ounces; Prussian blue, 1¼ ounces; Indian red, ¾ ounce; creosote, 3 drops. Grind all together on a stone slab, with a muller, to a very smooth and uniform paste. Any of the colors above enumerated may be substituted for the lampblack and other pigments in the above formula to produce colored inks.

In Germany an ink, prepared as follows, has been used, and is said to yield a very clear and fine impression when properly prepared: Venice turpentine, 2¼ ounces; soap, in thick paste, 2½ ounces; olein, rectified, 1 ounce; carbon black, 1¼ ounces; Paris blue, ¼ ounce; oxalic acid, ⅛ ounce; water, ¼ ounce.

The three last ingredients are mixed into a paste. The turpentine and olein are mixed at a gentle heat, the soap and carbon then introduced, and, after cooling, the blue paste is added, the whole being ground beneath a muller to a very fine and smooth paste.

The following are patented inks: Colophonic tar, 14 pounds; lampblack, 3 pounds; indigo, 8 ounces; Indian red, 4 ounces; yellow resin soap, 1 pound.

The colophonic tar referred to is the residuum from the distillation of rosin for rosin oil.

Linseed oil, 40 gallons; litharge, 4 pounds; lead acetate, 2 pounds.

The oil is heated to about 600° Fah., for from forty-eight to sixty-five hours according to quality of varnish required, the lead salts being added as driers. To each gallon of this varnish, 4 pounds of gum copal is added and dissolved. For common news ink the proportions are as follows: Of the above varnish, 15 pounds; rosin, 10 pounds; soap, brown resin, 2 pounds; lampblack, 5½ pounds.

A fine ink, suitable for use with rubber type, is prepared from nigrosine, soluble, 1 ounce; glycerine, pure, 4½ ounces; soap, white curd, ¼ ounce; water, *q. s.*

The nigrosine, finely powdered, is mixed into a stiff paste with the water, hot, and after standing a few hours this is mixed with the glycerine and soap, and the paste rubbed down with a muller on a hot stone slab.

For colored inks of this description the nigrosine may be substituted by almost any of the soluble coal tar dyes.

THE PROBLEM OF HEALTHY WATER.

Much complaint has arisen within the last two months, in this city, about the quality of the Croton water. It was alleged that it had a fishy taste that was far from agreeable, and apprehensions were expressed that it might be unfit for use. The Board of Health promptly had it analyzed and published the results. They were reassuring, and the public were told that they could drink all they desired with impunity. While this assertion was made on the strength of the analysis, it was fortified by the fact that no disease had been traced to the Croton, although it had been complained of for several weeks before the publication of the analysis. The timely investigation seems to have quieted the alarm, and in this way probably considerable good was done. Whether it proved anything concerning the water is another question.

A chemist or scientific man who takes the position of a non-alarmist where he can at all conscientiously do so, does much better than one who raises the cry of danger on a small provocation. This last has been done recently at the meetings of a certain social science association in the matter of adulteration. A certain person gave a formidable category of substances used for the purpose. It did not matter to him that some of the adulterants were more expensive than the original substances; he put them down in his list just the same.

But the question we are thinking of is whether the analysis proved that the Croton water was good. Water analysis is simple enough in its practice, but what is the verdict as to its value? Where it is necessary to know if water can be used for a steam boiler the determination of its solid mineral constituents can be made close enough without trouble. Even in this determination of the total mineral matters there are difficulties as yet unsolved. After the water is evaporated to dryness the organic matter is disposed of by ignition. In this ignition, however, some of the nitrates and carbonates present will be decomposed, and cannot be restored to precisely their original state. No question on its face seems simpler and is so hard in reality. Still, it can be done closely enough for practical purposes.

A reliable determination of the character of the organic matter, which was the vital point in our case, is unknown. All authorities admit its difficulty. Those who have their own methods uphold them, but still consider it an intricate question. The total nitrogen and albuminoid nitrogen found by the methods used by Dr. Waller are of value to a limited extent only. Water of a most dangerous character might pass the ordeal of such an analysis much better than a safe fluid. The above tests in this case bad a certain comparative value, as they were made in a regular series of Croton water analyses. It is from this point of view that they appear best. We do not doubt that on inquiry it would be found that it was their comparative value that the analyst would most insist on. It is easily conceivable that a water from the same source might acquire an additional amount of dangerous impurity and suffer a greater loss of innocuous organic substance at the same time. In such a case it would analyze better. It would have less organic matter and less nitrogen of both types. Yet it would be more dangerous, and the comparative value of the analysis would be *nil*.

The dreaded impurities are the fermentable substances and living organisms, or rather germs. Some years ago a simple test for urea, founded on its fermentation, appeared in our scientific journals. It was suggested as useful to distinguish contaminations of water with coal gas liquor and sewage respectively. Both these substances produce or contain ammonia, so that a test to distinguish the origin of that ammonia was very desirable. Here is a hint of what would be a grand achievement in water analysis; a reliable and practicable determination of the fermentable constituents. By the use of different reagents they might be distinguished from each other, just as the ammoniacal contamination due to gas liquor was distinguished from that due to sewage in the case just mentioned. Any animal or vegetable forms, too, might be classified into harmless and harmful ones. This would be the basis of a germ analysis.

The first of these suggestions may be carried out in the future, but so far it has not been realized. It is fraught with difficulties, among others the dilution in the water, and the easy destruction in laboratory operations of the substance.

The microscopic examination can, however, be even now conducted with some intelligibility, and might be made to yield valuable results.

Some authorities claim that a simple determination of oxygen required to oxidize the organic matter is enough. Others say the total organic matter is the essential thing. Some prescribe an analysis by combustion of the organic matter; others a determination of the two nitrogens or ammonias, total and albuminoid, in the wet way. "Where doctors disagree who shall decide?" says the proverb.

The problem is stated. A real valid method for the analysis of water is the want. The disagreement of experts among themselves proves that all must be dealing in uncertainties. Chemists would like nothing better than to see the vexed questions of their profession settled. They do not like uncertainties. They all wish to be positivists in science. In all the field of analytical chemistry there is hardly a more puzzling question than the above.

GEORGE STEPHENSON.

The centenary of the birth of George Stephenson, "the father of railways," was celebrated in England, June 9.

Stephenson was born at Wylam, eight miles from Newcastle-on-Tyne. His father was fireman at the near by colliery engine house. His mother was the daughter of a dyer. At eight years of age Stephenson herded cattle for a neighbor for a shilling a week, part of his duty being to shut the gates of the tramway from the pit, when the wagons passed, to keep the cows from straying. One of his early amusements was the modeling of an engine and winding machine like the one his father tended. At fourteen he was made assistant fireman, earning one shilling a day. Three years after he jumped his father's position and became engine man. At this time he could neither read nor write, but he knew his engine and critically studied its construction and working. About this period an old Scotch schoolmaster helped him to overcome the mystery of letters. At twenty-one he married, and after the birth of his son Robert, a year later, he removed to West Moor Colliery, Killingworth, where his wife soon died. For distraction in his bereavement he went to Montrose, Scotland, to superintend the working of a Boulton and Watts engine. He found the engine out of gear and the works choked, but soon had matters straightened and the machinery in proper working order. A year later his father was blinded by an accident; he was drawn in the militia for the Continental wars, and his prospects looked dark enough. To relieve his father's destitution and purchase exemption from army service used up his scanty savings, and he seriously contemplated emigration as his only chance for success in life.

The question of steam transit was becoming prominent during the early years of the century, and naturally enlisted the attention of Stephenson. The early locomotive makers contemplated engines for hauling wagons over common roads only; but Stephenson—thanks, no doubt, to his early observation of the advantages of rails while gate closer and cattle herder—foresaw that the road of the future must be a railroad, and planned his first locomotive accordingly.

In the fall of 1823 he constructed for the Hetton Colliery Company a short railroad, upon which, on the 18th of November, his locomotive hauled a load of sixty-four tons at the rate of four miles an hour. This demonstration of the feasibility of railways led at once to the Darlington and Stockton railway project, which won for Stephenson in Parliament and elsewhere the reputation of being a maniac leader of lunatics and fools. In spite of opposition the road was opened for traffic September 27, 1825, with Stephenson as engine driver.

The subsequent battle of the railway for leave to be, and of the locomotive for toleration after the railway was grudgingly accepted, is familiar history. No man ever fought a grander fight against popular and professional prejudice and ignorance, or developed in the fight a manlier character. His mental capacity rose with every great emergency, while his native shrewdness and solid sense ever kept him from undertaking the really impossible or impracticable, however extravagant or absurd his projects may have seemed to men of smaller capacity. What he knew he knew by personal mastery, not by hearsay; and without presumption or arrogance he was able by sterling intellectual power and sure-sightedness, backed by the hardest of hard work, to demonstrate the correctness of his ideas and to accomplish undertakings which involved the severest problems of railway engineering.

The moral of his life is clear, and should be pondered by every young mechanic. There is no condition in life, however hard or humble, which may not furnish the stepping stones to the most successful career. Had Stephenson been surrounded by wealth and educational privileges in early life, he might still have become a great man; but lacking his special experience as tramway gate tender and engine tender, dreary and discouraging as it may have seemed at the time, it is hardly possible that he would ever have been the pioneer of one of the most important and influential social and industrial movements of the race.

TWO RECENT BOILER EXPLOSIONS.

We give on another page an illustrated report of the recent explosion in New York harbor of the boiler of the steam tug Jacob Brandow on the 2d of June. The engineer, William R. Card, lost his life, and his son, John Card, the fireman, was badly scalded. The cause of the catastrophe is plainly shown in the report of our expert, namely, bad construction of the water leg of the boiler, from which leakage and corrosion ensued.

The boiler explosion which took place at the dye works of Messrs. Gaffney & Co., Philadelphia, on the 1st of June, resulting in the death of three persons and the destruction of buildings, has caused considerable comment among steam engineers. This boiler was one of a nest of three, was of the ordinary cylindrical type, 30 feet long, 36 inches diameter, with flat cast iron heads, having a large central man hole in the front head. The Hartford Boiler Inspection and Insurance Company had examined the boiler not long prior to the explosion, and pronounced it perfectly safe for the work and pressure required.

From the evidence before the coroner's jury it would seem the safety valves were set to blow off at 60 lb., and usually did blow at about that pressure, or not exceeding 62 lb. But precisely what the pressure was at the time of the explosion does not appear. The explosion lifted the boiler from its place and sent it like a rocket over into the next block, where it landed without particular injury to its shell.

The front cast iron head was found broken into several pieces, the lines of fracture radiating from the man hole. This seems to indicate that it was the weakness of the cast iron head that caused the mischief.

The testimony of several experts was introduced before the coroner's jury, showing that flat cast iron heads, although extensively used, are necessarily unsafe and dangerous, as they are apt to have hidden flaws; and one of the experts, Mr. Le Van, expressed the opinion that the two remaining boilers, which are of similar construction, are liable to blow up at any moment for the same reason, namely, cast iron heads. On this evidence the jury went the whole figure, and censured the Hartford Inspection Company in the strongest terms, declaring that its agents were negligent and incompetent when they inspected and certified that this boiler was safe.

We have in type for our next number a full report of this explosion, with engravings taken from photographs, which will very fully set forth the nature of the catastrophe, and perhaps afford some useful suggestions for the guidance of engineers and inspectors.

CONCENTRATING OR STORING UP ELECTRICITY.

Several years ago M. G. Plante, of France, made a secondary electrical battery, in which the electrical power of several ordinary cells could be concentrated or stored up within one cell, and the electrical force so gathered could be used when wanted. This battery consisted of two electrodes made of sheet lead, separated by strings of rubber, and placed in dilute sulphuric acid.

To charge this battery its poles were connected with an ordinary Bunsen or Daniell cell. During the operation of charging, one of the electrodes oxidizes, a brown coating of peroxide of lead soon showing itself thereon, and the metallic appearance disappears entirely; the other electrode also changes in appearance, its surface becoming covered with a powdery gray coating. When thus charged the secondary battery was capable of delivering an electric current of very much greater force than an ordinary cell of same size. This secondary battery is capable of charge and discharge indefinitely. M. Faure has lately improved upon the Planté battery, by painting the lead sheets with red lead. Simple as the improvement is, the resulting effects are quite remarkable, the storing capacity and delivery of the battery being greatly increased. The chemical action that takes place is substantially the same as in the original Planté battery.

It is stated that one of M. Faure's secondary batteries, weighing 165 pounds, is capable of delivering a force equal to one horse power during a period of one hour. If this is so it would bring the weight of an electromotor and battery of one horse power within a gross weight of 200 pounds, and suggests, as one of the possibilities of the new discovery, the production of a carriage propelled by electricity, convenient and economical in use.

For the benefit of those who desire to try this interesting electrical contrivance, we give on another page an illustration in explanation of some recent impromptu experiments on the subject lately made in our office. Any intelligent person who has at hand a few sheets of lead may readily construct the new battery.

Professor Sir William Thomson, of Glasgow University, who has lately experimented with these new batteries, mentions the use of one of the cells, weighing 18 pounds, which Professor George Buchanan took with him in his carriage and successfully employed in removing a tumor from a child's tongue by heating a platinum wire. To have accomplished the same effect by the ordinary electrical means would have required the setting up of several voltaic cells, and involved much inconvenience. Professor Thomson anticipates that this method of storing electricity will have many practical uses. He speaks as follows:

"The largest useful application is waiting just now for the Faure battery, and I hope that a very minimum time will be allowed to pass until the battery supplied for this application is to do for electric light what a water cistern in a house does for an inconstant water supply. A little battery of seven boxes suffices to give the incandescence in the Swan or Edison lights to the extent of one hundred candles for six hours without any perceptible diminution of brilliancy. Thus, instead of needing a gas engine or steam engine to be kept at work as long as the light is wanted, with the liability of the light failing at any moment through the slipping of the belt or any other breakdown or stoppage of the machinery, and instead of the wasteful inactivity during the hours of the day or night when the light is not needed, the engine may be kept going all day and stopped at night, or it may be kept going day and night, which undoubtedly will be the most economical plan when the electric light comes into general enough use.

"Another very important application of the accumulator is for the electric lighting of steamships. A dynamo-electric machine of very moderate magnitude and expense, driven by a belt from a drum on the main shaft, working through the twenty-four hours, will keep a Faure accumulator full, and thus, notwithstanding the irregularities of the speed of the engine at sea, or the occasional stoppages, the supply of electricity will always be ready to feed the Swan or Edison lamps in the engine rooms and cabins, or arc lights for the mast-head, and red and green side lamps, with more certainty and regularity than have yet been achieved in the gas supply for any house on *terra firma*."

American Science Association.

The Thirtieth Annual Meeting of the American Association for the Advancement of Science will be held in Cincinnati, beginning August 17. It is expected that the changes in the constitution proposed at Boston last year will be ratified, and the association reorganized in eight sections of equal standing, each having its own presiding officer, secretary, and committee. The proposed divisions are:

Section A—Physics; Section B—Astronomy and Pure Mathematics; Section C—Chemistry, including its applications to Agriculture and the Arts; Section D—Mechanical Science; Section E—Geology and Geography; Section F—Biology; Section G—Anthropology; Section H—Economic Science and Statistics. Also, I—A Permanent Subsection of Microscopy.

Arrangements are to be made for excursions of the anthropological section to some of the prehistoric mounds and relics in Ohio, including Fort Ancient, at Madisonville. The headquarters of the association and the offices of the local committee will be at Music Hall.

Through Railway Connection Under New York.

A company has been organized to connect by a tunnel railway the Hudson River Tunnel and the railroads which enter the city from the north and east by way of the Fourth Avenue improvement. The route will be from the outlet of the Hudson River Tunnel, under Wooster Street and University Place, to Fourteenth Street, thence by a curve under that street to Fourth Avenue, under which it will run to Forty-second Street. It is to be a double track road at least eighteen feet below the surface. The object is to carry freight and ultimately passengers under the city to New Jersey, so that cars may run direct from Boston or Montreal to New Orleans, Charleston, and other Southern cities without the annoyance and delay of a New York transfer.

Asbestos in the Black Hills.

Among the new discoveries made within the past few months is a large body of asbestos. This was discovered by Mr. T. B. Leavenworth, about six miles from Deadwood City. The croppings can be traced for nearly three hundred feet, while a large body of it has already been unearthed. Tests have been made which prove that this body of asbestos is equal to any yet discovered in America. It may be that this mineral will not come into immediate use, adds the *Pioneer*, but the day is not far distant when it will become an article of export from the Hills.

New Remedy for Baldness.

In cases of confirmed baldness the new remedy proposed is to remove the scalp, bit by bit, and substitute, by skin grafting, pieces of healthy scalp, taken from the heads of young persons. The success which has heretofore attended operations of this nature in cases of scalp wounds gives a promising outlook for this new mode of curing baldness; and perhaps the day is not far distant when the shining pates of our venerable fathers will bloom with the flowing locks of youth.

The Largest Grain Elevator.

The new elevator just completed near South Ferry, Brooklyn, is described as the largest in the country. It has been over a year in building, and has cost nearly $2,000,000. It has a storage capacity of 2,500,000 bushels, besides superior transfer facilities and dockage for half a dozen vessels, which can load at one time. The machinery is contained in an independent engine house and three enormous towers. The warehouse proper consists of a large number of separate fireproof stores.

MR. WILLIAM CLARK, who died at Philadelphia last week, in the 91st year of his age, was one of the oldest manufacturers of mathematical and nautical instruments in the country. He was born in England, and came to this country in 1820. Two of Mr. Clark's sons are engaged in the mathematical department of the Coast Survey Office at Washington.