

rapidly as into a perfect vacuum. The bearing of these facts on the question of the proper size for ports and pipes in steam engines will be readily seen.

It appears from the first clause of the article on page 50, that some of the readers of the SCIENTIFIC AMERICAN are seeking information on this subject. I would refer such to the *American Journal of Science*, 2d series, vol. 5, page 78, where they will find the true law of the flow of elastic fluids set forth and mathematically demonstrated, and to vol. 12, page 186 of the same journal, where they will find the same law completely confirmed by experiment.

New Haven, Conn.

ELI W. BLAKE.

#### Business Correspondence.

MESSRS. MUNN & CO.:—I herewith acknowledge the receipt of the official notice allowing a patent for my Can Opener, and I deem it my duty to thank you for your prompt and able management of my case. This is the third patent which you have obtained for me this year.

I have received several circulars from various patent attorneys residing in Washington, who offer their services free of charge until a patent is obtained. But I assure you, gentlemen, that I would sooner pay you your charges in advance, and run the risk of losing the amount along with the first Government fees, than to trust such agents with any business of mine. Therefore I care not whether they are capable or honest so long as I am satisfied with your manner of doing business.

I will cordially recommend your Agency to such of my friends as may need the assistance of patent attorneys.

I am, sirs, very respectfully yours,

WM. M. BLEAKLEY.

Verplanck, N. Y., Sept. 29, 1869.

MESSRS. MUNN & CO.:—I have received the two patents, one on a Bolt Heading the other on a Hook-Bending Machine, which you have obtained for me. Allow me to express my appreciation of the able manner in which my specifications and claims have been prepared, and to thank you for having so speedily obtained favorable decisions from the Patent Office.

Any influence which I can have in this part of the country, I assure you will be in your favor. Truly yours,

D. G. MORRIS.

Catasauqua, Pa., Sept. 16, 1869.

MESSRS. MUNN & CO.:—I received the patent on the 17th and the copies on the 20th.

I am so well satisfied with the manner in which you prosecuted the application to a successful termination that I shall give all such business to you in the future, and will influence any person—needing the services of a trustworthy and intelligent attorney—among my acquaintances, to give their business into your hands. I am truly yours,

LEVI S. IVES.

Pittsburgh, Pa., Sept. 21, 1869.

MESSRS. MUNN & CO.:—We have received our patent, and are highly pleased with the way in which the business has done. The ability which carried it through, and the care bestowed on its preparation, are above praise, and we will gladly intrust to your hands any further business we may have to do. Very truly yours,

J. H. WILDASIN & J. A. PECK.

St. Charles, Iowa, Sept. 24, 1869.

[We are constantly receiving warm commendatory letters like the above, from our many clients. The Patent Soliciting Department of this Office is going on with marked success, and inventors who contemplate taking out patents for their improvements can always avail themselves of our advice and assistance on the most favorable terms.—EDS.]

#### New Cornish Engine.

We learn from the *Press* (Philadelphia) that the Cornish engine just started to work at the Schuylkill Works differs from the ordinary Cornish engines in having the heavy lever beams placed down upon each side of the cylinder, with their bearings resting directly upon the bed-plate and stone foundation, instead of over the cylinder, in the usual manner.

By this plan much greater stability is secured, and expensive alterations and additions, which would have been necessary with the ordinary form of engine, were avoided.

The size of the steam cylinder is 72 inches diameter and ten feet stroke, and the pump plunger is 36 inches diameter and ten feet stroke. The beams weigh about 28,000 pounds each, and the load in the plunger is about 60,000 pounds. This machine is capable of raising 7,500,000 gallons of water per twenty-four hours.

The action of the engine is peculiar. The steam is admitted upon the top of the cylinder, and after the piston has passed through about one-third of its stroke, the steam is cut off, the rest of the stroke being made by the expansion of the steam in the cylinder. The plunger has now been raised to the top of its stroke; a valve is then opened allowing the steam on the top of the piston to pass to the underside of it, thus putting an equal pressure on both sides of it, and allowing the plunger and its weight to fall by its own gravity and thus force the water to the reservoir. It will be seen that this plunger must, therefore, be heavy enough to lift the load of water in the main, and also to overcome the friction of the water in the pump and pipes.

The engine was designed by the Chief Engineer of the Water Department, Frederick Graff. In order to be able to make the contractors for the building of the engine (Messrs. Merrick & Sons) entirely liable, they were intrusted with the

design for the details of parts, and are by their contract held responsible for the strength and proportions of these details. The engine is a splendid specimen of massive machinery, and reflects great credit upon Mr. Graff and Messrs. Merrick & Sons. The water is forced into the stand-pipe at the works, and thence through a main 36 inches in diameter and 312 feet long to the reservoir.

The engine is at present worked by the old boilers. The appropriation for the new set of boilers intended for her was delayed more than eight months by the refusal of the Democratic members of Select Council to vote for the loan asked for their erection. They are now in place at the works, and will be put into use in a few weeks.

(For the Scientific American.)

#### DETERMINATION OF THE AMOUNT OF EXPANSION OF MINERAL OILS.

BY PROF. VAN DER WEYDE.

In order to remove all doubts concerning the amount of expansion of petroleum, to prove that it does not expand more than whisky, and less than alcohol and most of the acids and oils, as stated in my communication to the SCIENTIFIC AMERICAN, page 38, current volume—I give here some of the data on which my statement was founded; and will exhibit only a few of a great number of determinations which I have made to settle this question, selecting those which recommend themselves by simplicity, because of the round numbers obtained.

##### First Method by Means of the Specific Gravity Bottle.

A small bottle, with ground-glass stopper, made so as to contain, when entirely full, exactly 50 grammes of pure distilled water at 65° Fah., was filled with heavy kerosene, the product of the last stages of distillation, marking 30° on Baumé's hygrometer; it contained at 32° Fah. exactly 44 grammes of the oil. When heated to 212°, a certain quantity of oil did overflow, and after cleaning and cooling [the weight of a hot object cannot accurately be determined on a sensitive balance, because of the air currents generated; this as a hint to young chemists] it was found to contain 41.15 grammes, proving an expansion of 2.85 grammes, or 6.5 per cent of the whole. As, however, the glass of the vessel expands, according to Regnault one 290th of its volume, this fraction of the 44 grammes has to be added for correction; it is nearly 0.15 grammes, which makes the expansion of the oil from 32° to 212° Fah., equal to 2.85 + 0.15, or 3 grammes, which is one 14.7th part of 44 grammes, and an expansion of 6.8 per cent., or 0.068. Other determinations with the same oil gave sometimes 0.069, 0.070, and 0.071.

Common kerosene of 49° Baumé was placed in the specific gravity bottle, and one of the samples gave, at 65°, exactly 40 grammes; heated to 125° it gave, after correction for glass expansion, 1 gramme less, being 0.025 for 60°, consequently 0.075 for 180°. When cooled to 35° it gave a contraction in bulk of 0.048 gramme, or 0.012th part of 40 grammes, corresponding to an expansion of 0.012 for 30°, or 0.072 for 180°. When heated from 120° to 180°, the expansion was found to give a coefficient of nearly 0.079.

On these facts I founded my statement referred to, that the rate of expansion is less between 32° and 60°, and more at about 180° than the mean expansion, which is 0.076.

Light gasoline of about 90° Baumé was experimented upon, one sample gave for contents of spec. gr. bottle at 30° Fah., 32.43 grammes, and at 60° exactly 32 grammes. This gave an expansion of 0.43 grammes for 30° Fah. of heat, or one 74th part of the whole, which would give for 180° a little more than one twelfth, or 0.083—a rate of expansion only slightly larger than ether and turpentine, equal to most animal oils, but considerably smaller than alcohol, nitric acid, olive, and linseed oil.

In crude petroleum the expansion was found always between 7 and 8 per cent, and in proportion as they were heavy or light, it was nearer to the first or to the second of these numbers.

##### Second Method by Means of the Hydrometer.

When placing a thermometer and hydrometer in kerosene of 40° Baumé, at 65° Fah. temperature, and heating it to 125°, the hydrometer will sink and indicate 46°; as now 40° Baumé corresponds with a specific gravity of 0.83, and 46° Baumé with 0.819, it indicates an expansion of 0.03—0.819, or 0.021, which is the 40th or 0.025th part of 0.83, this amount for 60° gives 0.075 per 180°, the same as found above.

It will be found, in general, that for every ten degrees increase of the thermometer the hydrometer sinks one degree lower, and vice versa. For the lighter oils, a little above nine degrees Fah. will correspond with one degree difference in the hydrometer, and for the heavier oils 10.5° to 11° Fah. of heat will be required to make this difference, but in general ten degrees heat for one degree gravity is near enough for practical purposes; and, in fact, this is so well known that it is depended upon by experts as a necessary correction in determining the quality of different grades of oil. As 50° and 60° Baumé, respectively, correspond with a specific gravity of 0.785 and 0.769, the difference of these last numbers, 0.016, correspond with 18° of Baumé's scale, which, again, correspond with the expansion for 180° heat. Every degree of Baumé's scale corresponds thus with 0.076 divided by 18, or 0.0042, nearly, for the corresponding difference in specific gravity.

##### Third Method by Means of the Thermometer alone.

When taking a correctly graduated alcoholic thermometer, breaking the top open, heating the bulb so as completely to remove the alcohol, and then filling it with petroleum to such an extent as to make the freezing point of water 32° Fah. on the scale, to correspond with the surface of the petroleum in the tube when cooled to 32°, then placing this thermometer in hot water of 123°, as indicated by another thermometer,

then the petroleum thermometer will only indicate about 100° on the scale; as the scale was constructed for the alcohol, its degrees are as much too large for the petroleum degrees as the expansion of alcohol exceeds that of petroleum; in this case it is found that 122—32 or 90 parts of alcohol correspond with 100—32 or 68 parts of petroleum; these numbers—90 and 68—are nearly in the same ratio as 0.100 and 0.076, the numbers expressing the ratio of expansion of alcohol and petroleum—another verification of the statements in the table published on page 38, already referred to.

When we consider the simplicity and reliability of all these methods, by which the rate of this expansion may be determined, and the perfectly accurate manner in which they corroborate one another, it is indeed surprising that M. Deville, before the French Academy, dwells so largely on the "very great expansion in bulk which mineral oils undergo by increase of temperature," and that when "barreled during the cold season it will expand largely with the first appearance of hot weather, and burst the vessels, on the same principle that ice ruptures our hydrants." [See SCIENTIFIC AMERICAN, page 376]. That M. Deville does not communicate the ratio of this, according to him, so extraordinary expansion, is not truly scientific, and makes his whole statement unreliable.

I adhere to my opinion expressed before, that the cause of leakage of petroleum barrels by heat, is the elongation of the iron of which the hoops are made, which makes the staves loose; besides this, the staves will contract from the same cause, which increases the leakage; and to this the extreme penetrating power and volatility of the lighter portions, chymogene, gasoline, etc., which is so largely increased by any rise in temperature, and we have a perfectly satisfactory explanation of the increase of danger in hot weather.

#### Why Coffee is a Stimulant.

The changes which heat effects in the elements contained in the green coffee berry have been little studied; we merely know, from the researches of MM. Baitron and Fremy, on the one hand, and of M. Payen on the other, that the brown bitter substance and the aromatic principle are produced by the decomposition of that part of the coffee bean which is soluble in water, and that a large part of the caffeine disappears during the roasting. It is said that this (caffeine) is carried away with the volatile products generated in the operation.

By roasting coffee in an apparatus which allows of the recovery of all the volatile products, I have ascertained that if caffeine be carried away with the volatile products, it can only be in such small quantity as is not appreciable by weight, and cannot explain the considerable loss which takes place during roasting carefully performed. The loss is experimentally found to equal nearly one-half of the caffeine originally existing in the coffee. I have succeeded in demonstrating that the lost caffeine has been transformed into a volatile base—methylamine, or methylammonia (C<sub>1</sub>H<sub>5</sub>N), which was discovered by M. Wurtz. The following are the facts which prove the change of caffeine into methylamine during coffee-roasting:

If pure caffeine be submitted to the action of heat, and the vapor be carried through a tube heated to about 300° Cent. (about the heat which is necessary for roasting), and filled with fragments of pumice-stone, which delay the passage of the vaporized matters, only a feeble decomposition occurs; the greater part remains unchanged, and the little that is decomposed gives no characteristic product except cyanogen. This experiment tends to prove that it is not the caffeine which furnishes the volatile alkaloid existing in roasted coffee. But a very different result is obtained if, instead of acting on free caffeine, we experiment on caffeine in analogous circumstances to those in which it exists in green coffee. M. Payen has, in fact, shown that caffeine exists in that berry in the form of the tannate, i. e., a combination of caffeine with a tannin peculiar to coffee. On submitting to the action of heat the tannate of caffeine which has been prepared with tannin of gall-nuts, we obtain, as with green coffee, methylamine: this compound behaves, under the influence of a temperature of about 300° Cent., in a manner similar to the tannate of caffeine first isolated by M. Payen. The whole of the methylamine produced during the roasting of coffee is not found in the solid residue; a certain proportion escapes with the volatile matters. It is easy to extract the alkaloid from roasted coffee by distilling the extract of coffee, made with cold water, with a weak base, such as lime. The addition of this alkali to an infusion of coffee immediately liberates the methylamine, the special ammoniacal odor of which is readily perceptible.—M. Personne.

#### Advertising Made Easy.

At a recent meeting of the "Society of Practical Engineers," one of the Society's M. D.'s read an elaborate paper on water meters, and closed with an eloquent description of a meter which the speaker had himself invented. He believed that he had made the most accurate, the most simple, the most durable, and the cheapest water meter in the world, and he invited for it the closest scrutiny and investigation of all concerned. This apparatus, he said, could be furnished at two dollars apiece.

This is certainly cheap enough; we had no idea that an accurate, simple, durable water meter could be had for so small a sum of money. Besides, we are pleased to notice the liberal conduct of the learned society, in permitting the discoverer to eulogize the merits of the meter in the proceedings of the evening. The Secretary of the Society will please send us its advertising terms.

THE Snorer's Companion is the name of a newly patented device to be attached to the backs of church pews, forming a comfortable head rest, and enabling the owner to sleep through the dullest sermon with the greatest satisfaction.