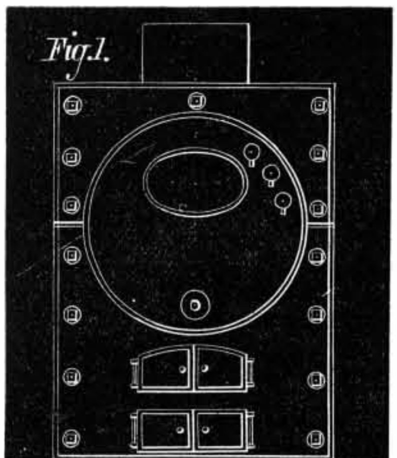
SETTING BOILERS.

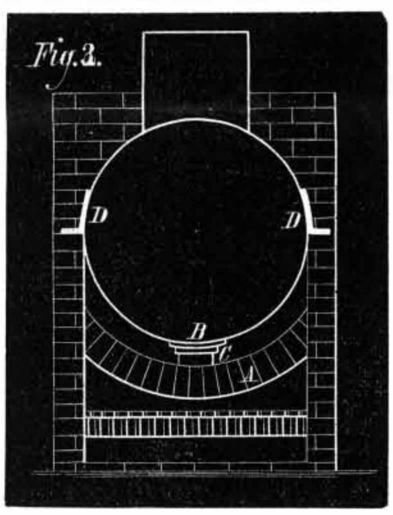
This subject seems to be generally neglected by writers on the steam engine. When a boiler is to be set, the ordinary plan is to send for a mason and entrust the work to him, without giving any specific directions. The result of such a course can easily be foreseen, and an examination of numerous boilers shows that there seem to be no rules for setting them that are adopted as standards. The practice of boiler makers, who furnish the necessary irons for setting boilers in brickwork, is also quite varied; so that a mason, however experienced he may be, cannot always do the work in the best manner possible. In view of these facts, it may not be amiss to devote a little space to the description of the best methods in use.

I.—THE BOLTS AND CASTINGS.

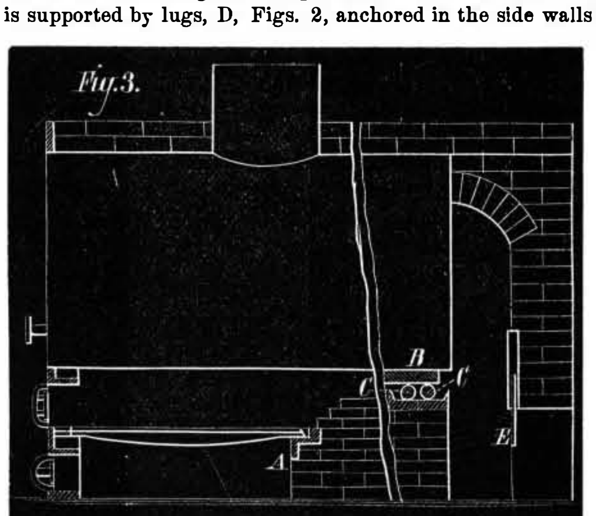
The irons usually employed in setting a boiler in brickwork are: The front, tie bolts, bearing bars, grate bars, supports, damper, connection, and chimney doors.



The front, shown in Figs. 1 and 4, should be made high enough to extend above the top of the boiler, so that the side walls and back can also be built up and the boiler covered on top. For the sake of cheapening the price of the fixtures, some boiler makers furnish a low front, so that, when the boiler is set, the top is left uncovered. Although this plan reduces the cost of the fixtures and setting, it is the dearest in the long run, since there is a great loss of heat by radiation from the uncovered portion of the boiler.



The supports for the boiler may be of two kinds, a single support at the end for a boiler of ordinary length, and intermediate supports for a long boiler. The best form of support for the end of a boiler is shown in Figs. 2, 3, 5, and 7. The boiler rests on a cast iron saddle, B, which is supported on rollers, C, the latter resting on a plate, D, on the brickwork. By this arrangement the boiler is free to expand and contract under changes of temperature. Sometimes the boiler is supported by lugs, D, Figs. 2, anchored in the side walls;

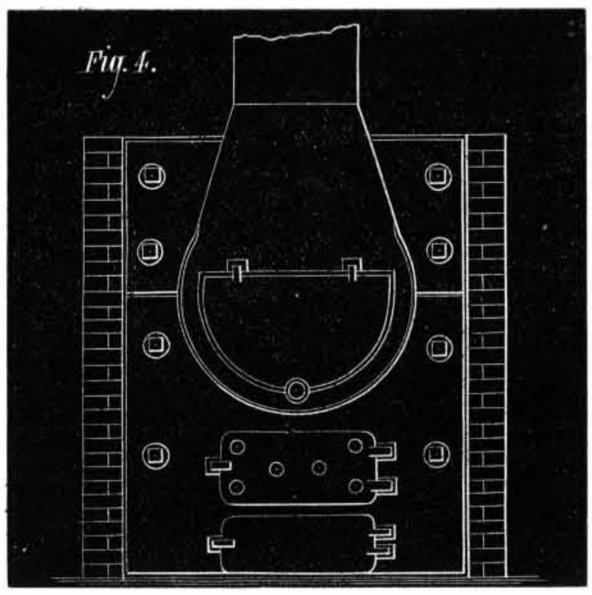


but this should only be done in the case of very short tubular boilers, and the roller support is preferable for every case. Very long boilers require to be supported at intermediate points. This is commonly done by means of suspension rods, which can be adjusted by nuts, but this practice is by no means commendable. When a fire is made under a long boiler, the bottom becomes more highly heated than the upper portion, so that the boiler tends to take a curved form

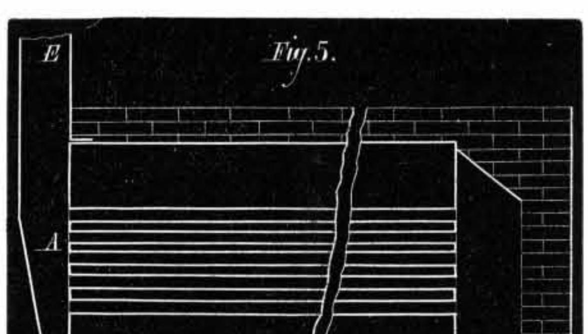
If rigid suspension rods are used, this curving is prevented, and in many cases fracture occurs, or the boiler is said to break its back. Mr. Head, an English engineer, has devised a form of suspension rod, which is easily constructed and effective. This is represented in Fig. 7. The suspension rods, E, are attached to a plate, D, on the boiler, and, instead of being rigidly secured by nuts to the guard, F, have stiff volute springs, G, which keep the boiler in proper position when cold, the rods having lugs, e, to check the action of the springs at the proper point. Of course, when the boiler is heated, the springs will allow it to be drawn down, and it will return to its normal position when cooled. If the weight of water in the boiler is considerable, suspension from the top might produce distortion of the circular form; and to counteract this, a piece of angle iron, H, may be secured within the boiler.

Tie bolts are often used to connect the two side walls. The ordinary form is represented in Fig. 6, the bolts passing through castings, B, which act as large washers.

The damper is generally a slide, as shown at E, Fig. 3, which is placed at the junction of the back connection or connecting flue with the chimney. Openings should be left large enough to permit a person to enter the back connection and chimney, and these are closed by the connection and chimney doors.



The bearing bars are for the supports of the grate bars. The front bearer is often cast on the front, or bolted to it, and the back bearer is laid on the bridge wall. In the case of long grates, an intermediate bearer is required, which is anchored in the side walls, and supported on the middle on bricks, if the grate is also very wide. It is better, however, instead of using one wide furnace, to divide it by walls or arches into several narrow ones, both for convenience and economy in firing. Wide furnaces have sometimes been divided in this manner, after the boilers were set, producing a considerable gain of efficiency. The arrangement of the boiler front fixes the position of the grates, or their distance below the boiler. There is not a great deal of difference in the practice of boilermakers, with respect to this distance, which is usually between 18 and 24 inches—generally nearer the former figure.

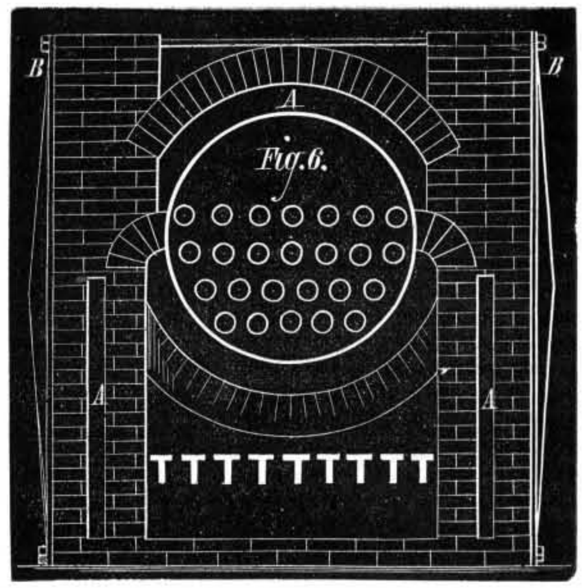


It is obvious that the iron front can be dispensed with, if desired, and the boiler sustained on brickwork alone. This is quite frequently done, but the plan does not appear to possess any special advantages, since, if the setting is properly performed, it will be quite as expensive as if the iron front were used.

II.—THE BRICKWORK.

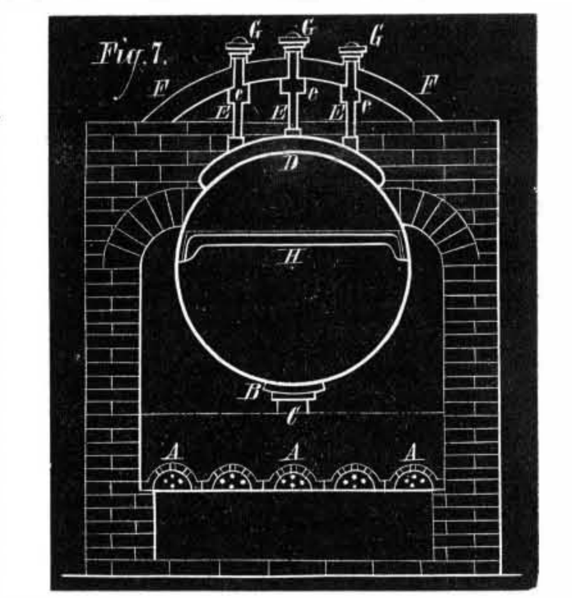
The general arrangement of setting for a plain cylinder boiler is shown in Figs. 1, 2, and 3, and calls for little remark. In the engravings, the top of the boiler is covered with brickwork; but it is a very common plan to run up the walls to a sufficient hight, and fill in the space with dry earth or sand. Whichever course is pursued, the brickwork should be carried up high enough around the boiler to make a tight joint, so that none of the heated gases can escape. It will be seen that an arch is turned to form the bridge wall. This, however, is a matter of no importance; and if is more convenient, a horizontal bridge wall can be built, care being taken to leave the proper opening between the wall and the boiler for the passage of the products of combustion. An average value for the proper area over bridge wall is three twentieths of the area of the grates; and though in practice this area is very differently adjusted by different masons, the best results are obtained when the area is an approximation to the figure given above.

In the engraving the grate bars are set level. They are frequently dropped a little at the back, on account of some supposed advantage in firing. There is no objection to this practice, and it is extremely doubtful whether any benefit is derived from it. It will be seen that the front is secured to the brickwork by bolts, which are built into the wall, with large washers on the ends. The boiler front, the side walls, and the bridge walls should be lined with fire brick set in fire clay. If any pipes are brought from the boiler through the brickwork, openings should be made for them, closed with iron doors, so that they shall be readily accessible for exami-



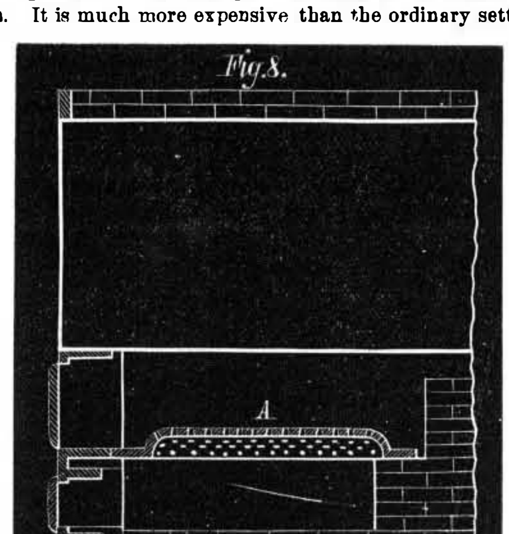
nation and repairs. It is better, however, to attach the pipes to the front or back of the boiler, where they need not be built in.

The setting suitable for a tubular or flue boiler is shown in Figs. 4 and 5. Here the products of combustion, instead of passing from the back connection to the chimney, return



through the tubes or flues to the front connection, A, and thence pass to the chimney by the flue, E. The engraving shows one of the best arrangements of fronts for this kind of boiler.

In Fig. 6 is shown what is probably the best manner of setting a boiler in brickwork, namely, with double walls and an air space, A, between, to prevent loss of heat from radiation. It is much more expensive than the ordinary setting,



and must be done with great care to make solid and stable walls

III.—FURNACES FOR SAWDUST.

There are several patent furnaces for burning sawdust and tan bark, which are said to be very economical and efficient; usually, however, in a sawmill it is more important to get rid of the sawdust than to burn it with great economy, and in such a case the furnace represented in Figs. 7 and 8 will answer every purpose. The boiler should be quite short, and the grate surface and area over the bridge wall should be about twice as great as for coal. A peculiar form of grate bars, known as cone grates, shown in the engravings, should be employed. These bars can be obtained from almost any builder of portable engines. The furnace should be set back some distance from the front, as shown in Fig. 8, leaving a flat plate, on which the sawdust is first piled, and gradually pushed upon the fire as it becomes dry. It is generally well to have at least two distinct furnaces, which can be fired alternately. It is also necessary to have a high chimney or a forced draft.

IV.—THE CHIMNEY.

The chimney may be constructed either of iron or brickwork, and as high as is convenient. It should be at least from 40 to 50 feet for good effect, and can, of course, have its hight increased to advantage. It is well to make the chimney with the same internal cross section throughout. It is generally considered that the circular section is better for a chimney than a square or rectangular section, and the interior should, of course, be made as smooth as possible. Chimneys are frequently constructed with double walls and an air space between, forming two distinct chimneys, the inner one of which is lined with or often wholly constructed of fire bricks. The cross section of a square chimney should be at least seventeen one-hundredths of the grate surface of the boiler, and for a round chimney, thirteen one-hundredths; but it is a good plan to make the chimney somewhat larger than this, since, if it is too large, it is easy to close the damper, but, if it is too small, the remedy is not so easily applied.

Correspondence.

A Lost Art Re-Discovered and Patented in America.

[From the following letters, furnished by a Detroit correspondent, it appears that, a hundred and fifty-five years ago, in 1720, in the quiet old town of Ross, Herefordshire, Eng., an ingenious individual, John Kyrle, celebrated in Pope's "Elegy" as the "Man of Ross," established a system of water supply for that town, which from that time to the present has been uninterruptedly in use. The distinctive feature of this system consists in forcing water by pumps into the street mains, so as to supply the town with water under such pressure as may be required. At the Ross works the ordinary pressure for many years has been 45 lbs. per square inch.

On March 2, 1869, the United States Patent Office grants a patent for the same system, as a new invention, to Birdsill Holly, and gives him a still broader claim in a re-issued patent, August 2, 1870. It would seem that the broad claim must now be abandoned. But the ingenious valves and the devices for regulation of the water employed in the Holly system will doubtless remain good.—EDS.]

To the Editor of the Scientific American:

There has been a great deal of controversy here about the Holly system of waterworks: Mr. Holly claiming that no one but himself can build waterworks pumping direct into the mains and keeping a pressure on them, as he holds letters patent from the United States for the same. Now, as I understand the law of patents in the United States, a patent will not be granted, and if granted will not be sustained, if the object sought to be covered by patent has been in use before. I have always contended that the "Holly system," so-called, was older than Holly himself.

You have no doubt read Alexander Pope's elegy on the Man of Ross (Mr. John Kyrle); and in thinking over this pumping work, I remembered having seen in my youth some very old pumping works at Ross, in Herefordshire, England, and, believing that they were on the same system as this under dispute, to make sure I wrote to the Mayor of the town of Ross, describing the Holly system to him, and have received his reply; and I would like to see it published (for the use of waterworks contractors and builders) in the SCIENTIFIC AMERICAN, which I believe all such persons read. The letter is as follows:

DEAR SIR:—As I was born in this town in 1812, spending the greater part of my 63 years here, I am enabled to give the information you require. I purchased the waterworks in 1849 and still own them. They were established by the "Man of Ross" about 1720, and have undergone but little modification until now, when steam power is supplemented. As you know, then the water wheel was about 11 feet diameter and 30 inches wide; it drove two six-inch plungers, and was direct-acting or without reservoir, exactly the same arrangement as you describe. It is so now, and I know of but little advantage in storage, except from intermittent sources of supply. * * * As you know the Royal Hotel, I may inform you that it is 94 feet above the plungers, so that I have more than three atmospheres at the works. I pump from the river.

Ross, October 12, 1875. S. B. WALL, Mayor.

You see by this that this system has been in use to our certain knowledge 155 years, and this should nullify any such claim as that made by the Holly Waterworks Company.

Detroit, Mich. W. PENDRY, M. E.

Silvering Glass.

To the Editor of the Scientific American:

Having had occasion to silver some small plates of glass, I tried several formulas. In some I found the silver solution so weak that it required repeated applications to give an opaque deposit. In others, the silver was so strong that there appeared to be a waste. After trying several modifications, I found that the following works very finely, giving a heavy deposit by a single application:

No. 1. Reducing solution: In 12 ozs. of water dissolve 12 grains Rochelle salts, and boil. Add, while boiling, 16 grains nitrate of silver dissolved in 1 oz. water, and continue the boiling for 10 minutes more, then add water to make 12 ozs.

No. 2. Silvering solution: Dissolve 1 oz. nitrate of silver in 10 ozs. water; then add *liquor ammoniæ* until the brown precipitate is nearly but not quite all dissolved; then add 1 oz. alcohol and sufficient water to make 12 ozs.

To silver: Take equal parts of Nos. 1 and 2, mix thoroughly, and lay the glass, face down, on the top of the mixture while wet, after it has been carefully cleaned with soda and well rinsed with clean water.

Distilled water should be used for making the solutions. About 2 drachms of each will silver a plate 2 inches square. The dish in which the silvering is done should be only a little larger than the plate. The solutions should stand and settle for two or three days before being used, and will keep good a long time.

New York city. D. C. CHAPMAN.

The Relation between Spectral Lines and Atomic Weights.

To the Editor of the Scientific American:

The following facts, disclosing an intimate connection between the Fraunhofer lines of the solar spectrum and the atomic weights of the substances whose glowing vapors they represent, will, if confirmed, prove of the highest importance and interest. Being desirous, on this account, of bringing them at once to general knowledge, I send you the following condensed statement, which I hope you will publish.

The Fraunhofer lines of hydrogen gas are, according to Angström's wonderfully accurate measurements (given in millimeters, a millimeter being 0·3937 of an inch):

0·00041012mm.
0·00043400mm.
0·00048606mm.
0·00065618mm.

Their distances from the shortest wave lengths are consequently:

43400 —41012=0·00002388mm.
48606 —41012=0·00007594mm.
65618 —41012=0·00024606mm.

Referring these distances to 0·00041012, the shortest wave length, as a common standard of value, the figures obtained are:

0·00041012 : 0·00002388=17·1742
0·00041012 : 0·00007594=5·7247 × 3=17·1741
0·00041012 : 0·00024606=1·9082 × 3= 5·7246

being to each other as 1—3—9. Supposing the quantity expressed by 1·0982mm. to represent 3 units of a certain measure of length, the distances of the H lines increase as the squares of 3: 3—9—27.

The H molecules of the solar atmosphere which give rise to these lines consist of ponderable matter; and (the mechanical force of the luminous impulses having been so recently demonstrated by Professor Stokes) the inference is that refraction, the angles of which are measured and expressed by the wave lengths, is the function of the energy proper to the different constituent particles of the luminous molecules: that these particles are held together by attraction, the common property of matter, decreasing inversely as the squares of distances.

On this supposition, the attractive forces of the H molecule proceed from a center where they are at their maximum; and the distances between the different constituents being known, the value of their attractive energy can be calculated from the constant relation between attraction and distance. To the distances 3—9—27 correspond the respective forces $\frac{1}{3}$—$\frac{1}{9}$—$\frac{1}{27}$; and a unit of force, by which the values of attraction of all solar substances can be measured and compared, is represented by the length of shortest waves. In dividing the atomic weights of the substances whose spectral lines are known by the length of their shortest waves, and converting the result into chemical weight by taking the quotient obtained for H=1, the values are as follows:

Atomic weight.	Shortest wave length.	Divided by 2438.
H =1·00	0·00041012=	2438=1
Ca = 40	0·00039330=	101704=41·72
Fe = 56	0·00039330=	142385=58·4
Al =27·3	0·00039428=	69240=28·4
Mn = 55	0·00039882=	137907=56·6
Ti = 48	0·00041631=	115299=47·3
Cr = 52	0 00042532=	122261=50·15
Ni = 58	0·00044020=	131758=54
Mg = 24	0·00044805=	53565=22
Ba =137	0·00045241=	302823=124·21
Co = 59	0·00045303=	130234=53·4
Cu =63·4	0·00046510=	136315=56
Zn = 65	0·00046790=	138919=57
Na = 23	0·00049825=	46137=18·9

Notwithstanding the differences, the figures of the last column so closely correspond to the atomic weights that the inference of a near relationship between the spectral lines and atomic weights seems irresistible. When the extreme faintness of the lines in the portion of the spectrum of the greatest refraction is taken into account, some of the difference may not unreasonably be attributed to the existence of shorter waves than those quoted. The definite proportions between differences and atomic weights point to this. Thus 18·9 is nearly $\frac{4}{5}$ of 23; the line corresponding to the atomic weight of 23 is 0·00040900: if this line, which really exists, should prove to belong to Na, the test would be decisive. The importance of the conclusions to be derived from the existence of such relations is apparent. The evidence of atomic molecules, when brought within the reach of scientific investigation, and their dependence on the general law of gravitation, would disclose the inner constitution of matter, the nature of chemical affinity and valency, and the nature of electricity and magnetism; and it would be instrumental in the solution of many problems.

San Francisco, Cal. E. VOGEL.

Poisoning by Strychnine.

To the Editor of the Scientific American:

I have seen in your issue of September 14 an account of the death of Dr. J. O. Hill, of Ithaca, N. Y., by strychnin, as described by S. J. Parker, M. D.

I once happened to receive a similar dose of strychnin, in the year 1853; but as I knew the remedy, I was cured, being promptly attended to by Mr. Gregson Harrison, who applied the means discovered by Dr. Crace Calvert, in 1852. The remedy is: To counteract strychnin, and cause it to be brought away by vomiting (if it has not been taken more than 30 minutes), pour down the throat $\frac{1}{2}$ grain of nitrate of soda every 20 minutes until vomiting takes place. The patient will then sleep about 40 hours, and awake all right.

The sensations caused by strychnin are first slight pains in the back of the head, then extreme cold in the toes, traveling up to knees; then cold in the fingers, traveling to the bottom of the breast bone. JOHN PEARSON.

Chorlton-on-Medlock, Manchester, England.

Specific Gravity and Dimensions of Molecules.

To the Editor of the Scientific American:

W. B. M, whose letter appears on page 244 of your current volume is laboring under a great mistake in asserting that the lightness of a substance is not evidence of its possessing larger molecules, and that, if this were true, it would at once dispose of the atomic theory.

I am at a loss to know what he is hammering at. He says: "Take absolute alcohol (specific gravity 0·8°) and you will find that, to two similar glassfuls of water, you will be able to add more alcohol than water before overflow." In this he is correct, and this disproves his argument.

But he is also mistaken as to specific gravity of absolute alcohol. Absolute alcohol has a specific gravity of 0·7939 when combined with water at its maximum density, (39·4° Fah.), water being 0·9991.

I stated that the specific gravity of absolute alcohol is 0·7939 and of water 0·9991, making a difference of 0 2052 in the specific gravity, showing that the molecules of alcohol are considerably the larger. Now let W. B. M. take 100 ounces of alcohol of 80 per cent (specific gravity 0·8631), and 104 ounces of water, and he will just have 200 ounces of diluted alcohol possessing a specific gravity of 0·9510, and a strength of 40 per cent. It will be seen that 4 ounces have disappeared, consequently the molecules in the mixture must be of less size than those in alcohol of 80 per cent.

He says that, in the case of heavy liquids, the heavier the liquid, the greater the volume which may be added without altering the apparent volume. Let him try mercury, and the result will be the same as if he had added an equal volume of water.

I have not as yet experimented with mercury, but I have with simple sirup; and I find less contraction caused than with water. I should like again to hear from W. B. M., and hope in his next he will be more explict. Instead of attempting to overflow a glass, let him employ a given volume of each liquid, and ascertain the resulting volume of each; in this way he can easily find what the greatest contraction caused by combination of liquids is.

San Francisco, Cal. PRO BONO PUBLICO.

New Mode of Cleansing Cloths and Yarns.

A patent has been taken out in France by M. A. Huet for compositions with bases of glycerin and soap, with or without the addition of an antiseptic, for the purpose of cleansing any textile matter. Glycerin, says the inventor, has the property of being soluble in all proportions of water, and also of dissolving nearly all the substances which water itself dissolves, such as salts, soaps, and metallic oxides.

Starting from this point, M. Huet, after many experiments, arrived at the following composition for wool, which he calls soluble *ensimage*:

Neutral glycerin at 28°	70
Soap	4
Water	24
Solution of oxide of mercury	2
	100

The sulphates, quinine, carbonic acid, etc., might be used as the antiseptic. But the antiseptic is not always necessary, in winter, when there is no fear of fermentation, for instance; for fermentation requires 77° to 86° Fah., and then takes months to establish itself. The solution must be well mixed and filtered.

M. Huet says that he has found, after careful trials, that, by substituting his composition for the oils and fatty matters in ordinary use, the necessity for cleansing cloths during manufacture was entirely done away with, and that they may fulled at once, without any previous preparation; and thus the danger is avoided of the tints being injured by long contact with the fuller's earth and the alkalies which are often obliged to be added to the earth in order to saponify the oils or other fatty matters. When it is necessary to get rid of size, a simple washing in water will remove both it and the glycerin composition at once.

In other branches of manufacture the yarns must be cleansed before weaving them, in which case also plain water will remove the composition at once. The inventor, therefore, claims for his method great economy in time and money.

The proportion of glycerin to other matters in the composition may be varied according to the nature and fineness of the wool, but that given above is the average amount.

THE strain on belts is always in the direction of their length: and therefore holes cut for the reception of lacings should be oval, the long diameter being in line with the belt