Science Familiarly Illustrated.

The Spheroidal State of Liquids.

When drops of water fall on a heated stove they assume the form of flattened spheres, roll about over the hot metal until dissipated by slow evaporation. This simple phenomenon was first brought to notice by Leidenfrost about a century ago, but it is to the later researches of M. Boutigny that we are mainly indebted for what knowledge of the subject we now possess. This philosopher christened this peculiar condition of liquids the "spheroidal state," and observed the following facts in relation to it: the temperature of the plate must be above the boiling point of the liquid; the temperature of the spheroid liquid—Boutigny found by immersing a delicate thermometer therein—is always lower and the temperature of the vapor is invariably higher than the boiling point of the liquid. If the experiment is tried with a heated plate of metal the liquid will continue in the spheroidal condition until the plate is cooled to a certain point, when the liquid will burst with an explosion into violent ebullition, and rapidly evaporate.

One of the most striking experiments which a knowledge of these facts led Boutigny to attempt was freezing water in a red hot crucible. He heated a platinum dish to redness, then placed in it a small quantity of sulphurous acid and a few drops of water. The former assumed immediately the spheroidal condition, and by its extremely low temperature readily solidified the water. Similarly Faraday, by using a mixutre of solid carbonic acid, succeeded in freezing mercury under like conditions.

Any liquid when in the spheroidal state is not in actual contact with the heated surface, but rests upou an interposed film of air, as on an elastic cushion. With a knowledge of this fact, the explanation is manifest, of the trick of placing the naked hand with impunity in molten metal. In this case the natural moisture of the hand assumes the spheroidal condition and acts as a shield or covering in preventing the liquid from coming in contact with the flesh. If the finger is drawn rapidly through the molten mass, the spheroids will be mechanically broken and unpleasant consequences must ensue. By first wetting the hand with ether it may likewise be safely plunged into boiling water.

An old Spanish proverb facetiously advises taking a basket to the well, or carrying water in a sieve. But these apparent absurdities have been actually accomplished, the success being due to the repulsive action of the liquid spheroids toward the heated surface. The original experiment Boutigny performed by heating to a red heat a basket formed of a net work of platinum wires. As long as this temperature of the metal was sustained water placed therein was prevented from passing through the meshes, but on gradually cooling the liquid was dissipated in vapor.

Boiler explosions may sometimes be explained by a knowledge of the facts relating to the spheroidal state of liquids, as when the supply is for any reason deficient, or as often happens on our steamboats stopping to load or unload freight or passengers, part of the flues are exposed to an undiminished fire by the careening of the boat. If cold water is now injected on to the red hot boiler it will first assume the spheroidal state, but almost immediately after will burst into a volume of vapor with a force sufficient to rend the boiler.

GLEANINGS FROM THE POLYTECHNIC ASSOCIATION.

The regular meeting of this branch of the American Institute, was held on Thursday evening, April 18th, Prof. Tillman presiding.

The hygrodeik illustrated in these columns some weeks ago, was exhibited before the association by its inventor; also a water meter which seemed very complete and efficient in its workings. Previous to the introduction of the regular subject for the evening, Prof. Vander Weyde spoke a few words in defence of American inventors, referring to the unwillingness of Europeans to yield to this class the right of priority in bringing out new ideas. The immediate occasion of his remarks was the receipt a short time since, of a letter from a friend in Europe, commending to his notice the use of laughing gas as a new anæsthesia in surgical operations of short duration; he replied that the application of nitrous oxide for this purpose was an American idea, and was extensively in use in this country.

At a recent meeting of the French Academy of Science the employment of this anæsthetic was disparaged because of alleged danger attending its use. In this country but one or two fatal accidents have ever been reported though the gas is so generally used in dental operations, and in these instances death was finally traced to other causes.

MR. PAGE ON PETROLEUM.

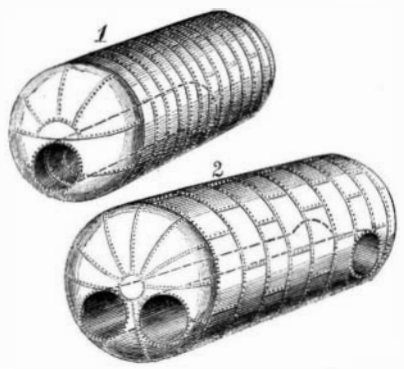
The purpose of these remarks was to show the connection existing between the lightest hydro-carbon oils and anthracite coal, proceeding in this order rather than in the ordinary way of tracing the origin of oil back to coal. The truth of his position Mr. Page sought to establish by exhibiting specimens of oil from all parts of the world, and of every grade of density. From the lightest oils he showed the different grades down to the heavy pitch of California; the gum beds of Canada, having the consistency of molasses; and finally bitumen, a substance so nearly identical with coal that some years ago in an important law suit chemists could not decide whether the coal of New Brunswick was in reality a coal, or an asphalt; a compromise being finally made and the name Albertite is now commonly given to it.

Mr. Page stated his belief that oil trickling down between the rocks, at first mixing with sand formed the coal shale, afterward the pure oil oozed in through the passage thus cleared, and by evaporation passed through successive changes, pitch, gum, bitumen, until finally it became a vein of true coal. The presence of fossils in coal, the speaker accounted for by referring to a statement made by Prof. Silliman, that if any living creature ventured into the pitch lakes of California, extrication would be an utter impossibility. Mr. Page spoke at some length and his remarks throughout were listened to by a large and attentive audience.

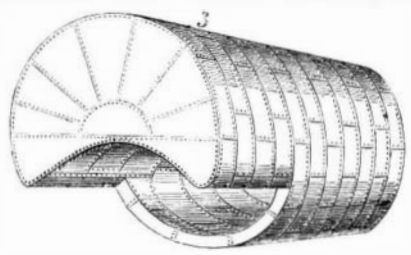
STEAM BOILERS---THEIR FORM, CONSTRUCTION, AND MATERIAL.

NUMBER THREE.

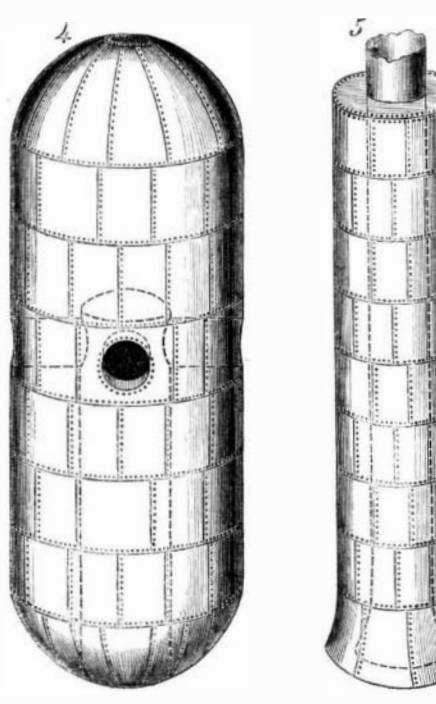
The device of internal tubes for increasing the heating surface of boilers was in use in the wagon boilers shown in the first article of this series, but it became much more common



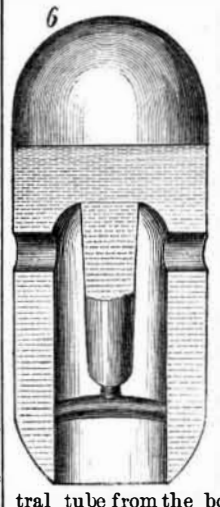
when the cylindrical boiler usurped their place. One of these is seen in No. 1 with a tube passing from the rear of the fire to the front of the boiler. No. 2 has two tubes which open at the front and at the sides near the rear end. Both these are externally fired. They are extensively used now



and are made as large as nine, ten, and even eleven feet in diameter, but these large sizes are an element of weakness. It may be questioned whether after the flame has passed nearly or quite the whole length of the boiler there can be much utility in returning the gases through



the tubes or flues, the principal advantage being in reducing the quantity of water in the boiler which is acted upon by the fire.



The wagon and cylindrical boiler were united in the Butterley boiler seen in No. 3. This is a cylindrical boiler having a wagon shaped projection over the fire, continuing as a gradually contracted flue through the boiler. It generates steam rapidly, but the part projecting over the fire has the inherent weakness of form which is the fault of the wagon boiler. So many of these boilers exploded that the fact prevented their very extensive manufacture.

Boilers of various forms for the utilization of the waste heat from puddling furnaces have been contrived, one of which, calculated for four furnaces, is shown at No. 4. This represents a boiler ten feet in diameter and twenty-eight feet high. It is an upright cylinder with hemispherical ends, having a central tube from the bottom to about half the hight, where it meets four transverse flues which open at the side. The heat from the furnaces impinges on a portion of the shell and entering the side flues passes down the center tube and off through an underground flue to the chimney. These are very strong boilers, presenting a large heating surface, and by the division of the heat all portions of the circumference of the shell are subjected to the same tension. The form of the ends insures very grest resistance to internal pressure, and the distance above the water line prevents priming.

Boilers for single furnaces called from their form, chimney boilers, have been extensively used. One is seen at No. 5, and is simply an upright cylinder with a tube running through it, the bottom and end of which is bell mouthed and the top end connected with the chimney flue. To protect the tube sheets from overheating where it passes through the steam chamber, it is lined with fire brick. No. 6 is a boiler having an internal fireplace of conical form with a suspended cone and cross pipe for increasing the heating surface. The shell is set in brick work in such a way that the heat passes through the side tubes and around the shell before passing off.

One form of the chimney boiler was called the elbow boiler and was merely a horizontal cylinder, having a downward projecting portion at right angles with the body, and in this the fire was placed, the heat of which passed through a tube conforming in direction to the angle of the boiler. The Cornish boiler is a horizontal cylinder with an internal flue of large diameter running from end to end. The fire was built in one end of this tube the products passing through the whole length of the boiler. This boiler is a great favorite from its great generating powers, economy, and durability, although there have been many instances of collapsed flues occasioned simply by weakness of construction. The Lancashire boiler contains two tubes or flues instead of one, but in other respects is similar to the Cornish boiler. An oval form, flattened from top to bottom, has been attempted for the purpose of reducingt he depth of the body of water above the flues.

In our next article we shall give some examples of explosions of the different classes of boilers already mentioned.

Correspondence.

The Editors are not responsible for the opinions expressed by their correspondents.

The Rights of Society and of Labor.

MESSRS. EDITORS:—Aremark occurs in your paper for April 27th, which will appear to many of your readers to require explanation in view of your natural position as a champion of workingmen. You say, speaking of the strike on the locomotives in England, "Society must and will exist, right or wrong, whatever else has to be crushed under its necessities." I should reply to this as the celebrated Frenchman is said to have done to the highwayman, who justified himself by saying that he must live:—"I do not in the least see the necessity." If the organization of society necessarily involves the "crushing" of anybody, the sooner a total reorganization takes place the better. The very same argument was used to justify and uphold slavery, yet that form of "society" was able to bear the upheaval, and the world "still lives."

It cannot be denied that the only redress the workingman has against the natural and unceasing inroads of capital is in concert of action; and his "necessities" are at least equal to those of "society." If the work of civilization *must* be done, let it be paid for. If it is so necessary, let the price be commensurate—at least let the workingman be considered a constituent of society, and not its slave. Thank heaven, the society alluded to is that of England, not yet of America.

Examples might be adduced, as that of the pilots on the Mississippi for instance, who ask and are able to command such compensation as seems to them a fair equivalent, and yet "society" does not go under. I will not enlarge, however, as I wish to be very brief, in order that you may be induced to print this comment and answer it fairly, as it is a practical question, and one of the deepest interest and importance, particularly if extensively misunderstood. HENRY HOBART.

Washington, D. C.

[Our remark will hardly "appear to require explanation" to those who keep awake while they read. But as some people *will* read without reflection or even attention, they must be reminded that the words quoted only say that society "*will* exist, right or wrong," but not that it ought to. We may add that, like our correspondent, we do not see the necessity for anything or anybody to exist in contravention of justice. But neither his opinion or ours will change human nature, or withstand the imperious necessities, real or supposed, of human society, and hence it is not best for parties to push their rights, real or supposed, to the point of forcible collision with those necessities, for they will certainly have to take the smash—that is all. Our correspondent is very careless again, in substituting for "society" which we said, "the present organization of society" which is quite another thing, and can be destroyed if justice or expediency require, as society itself can not.

Happily there is no possible antagonism, in the long run, between the interests of society and of any of its members. Justice to all is the only stable foundation of society Consequently, its inevitable maintenance, to which we referred, does not involve destruction to the interests of the producing classes, if they are maintained with a due regard to the rights of the whole. No community can or ought to flourish which does not recognize their just claims, with those of all others: but this question of the rights of labor and capital is one that has puzzled the wisest brains, and like all other great problems it will require time to work out the proper solution. It seems to be rapidly progressing toward the union of both parties in mutual interest, which we conceive to be the only equitable principle on which it can be adjusted. No country has a greater stake than our own in promoting the best interests of the working classes, and it is little to our credit that both Englishmen and Frenchmen are