Scientific American.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

NO. 37 PARK ROW (PARK BUILDING) NEW YORK.

O. D. MUNN. A. E. BEACH.

☞ "The American News Co.," Agents, 121 Nassau street, New York.
☞ "The New York News Co.," 8 Spruce street, New York.
☞ A. Asher & Co., 20 Unter den Linden, Berlin, Prussia, are Agents for the German States.
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VOL. XXVI., No. 9. [NEW SERIES.] *Twenty-seventh Year.*

NEW YORK, SATURDAY, FEBRUARY 24, 1872.

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SUBSTITUTING OTHER VAPORS FOR STEAM.---VAPOR OF LIQUEFIED CARBONIC ACID.

Most volatile liquids resemble water in this respect: That when heating them many degrees above their boiling point, the tension or pressure exerted upon the vessel containing them increases in an enormous ratio for a comparatively slight rise of temperature. The table below sllustrates this in regard to water and liquid carbonic acid; but it should not be overlooked that these pressures are only obtained as long as there is liquid present; when the last drop is evaporated, and dry steam or pure carbonic acid gas is obtained, the law for the expansion of gases by heat is applicable; the expansion being then uniform for equal degrees of rise in temperature, and by no means subject to the enormous increase experienced as long as unevaporized liquid is present.

If, then, we can get no advantage in using liquids requiring a small amount of latent heat for their evaporation, as shown on page 119, we may, by using liquids of very low boiling point, take advantage of the slight difference in higher temperatures, able to produce evaporation and condensation. If we would apply this principle in the use of steam, we stumble at once on the high temperatures required; if we heat water, for instance, in a closed vessel, from 212° to 248° Fah., we increase the pressure one atmosphere, that is, for 248—212 or 36° Fah. increase in heat, we increase the pressure only 15 pounds per square inch, scarcely half a pound for every degree of heat, while if we add the same quantity of heat to water previously heated to 473° and bring it to 509°, the expansive force of the steam will be raised from 35 to 50 atmospheres; this is 15 atmospheres or 15×15 pounds per square inch. The increase is now 15 pounds or one atmosphere for every degree of heat added. Two vessels of water thus, in which such a difference of temperature was maintained, could, when connected by proper arrangements, be made to exert this difference of pressure on both sides of a piston, and thus drive machinery, with a steam pressure of 15 atmospheres and even more, if a difference of more than 15° in heat was only maintained.

As said above, the very high temperature required is the objection to the use of this principle in the case of water and steam; but when going down to the bottom of the list of condensable gases, or to the top of the list of volatile liquids, and selecting one of the most volatile, say liquefied carbonic acid, which boils at 148° below zero, Fah., we have a liquid which, at the common temperature of say 60° Fah., will exert a pressure of 51 atmospheres, and at the freezing point or 32° a pressure of 38 atmospheres, giving thus a difference of 12 atmospheres or 180 pounds per square inch for only a cooling of 28°, which in the case supposed may be effected by means of ice. We have thus here a prime motor driven by the use of two reservoirs, the temperature of one of which is kept up at some 60°, simply by the heat of the surrounding air, while the other is cooled by ice and kept at some 32°; in this way, a power may be kept up equivalent to that produced by a high pressure boiler carrying 180 pounds of steam. The curiosity of this arrangement is the fact that in place of storing up coal for the production of heat, we store up ice for the production of cold. One great objection would, however, be that one pound of ice will only subtract, by its melting, 142 units of heat, while one pound of coal will, by its combustion, produce some 14,000 units of heat. We should thus require about 100 pounds of ice as equivalent for only one pound of coal; if we add to this the difficulty of keeping ice and the ease of keeping coal, and above all, if we consider the enormous strength of the vessels required, and also of the cylinders and connecting tubes, all able to stand about 1,000 pounds per square inch, making the apparatus heavy and dangerous: also if we consider the obstacles which such thick plates offer to the transmission of slight differences of temperatures, it is evident that such strong surface condensers cannot act properly; add to all this the expense of the liquefied carbonic acid, the ease of its escape when confined under the required high pressure, its corrosive action on the metals, the objection that such an engine would have to work with a back pressure on its piston of some 700 or 800 pounds per square inch, while the comparatively slight excess of 80 or 100 pounds would be the motive power, etc., and it is clear that the plan is utterly impracticable.

But the old saying of Cicero "that there is no theory so absurd that there are no philosophers to defend it" may be applied to inventors; and it may be said that no contrivance is so objectionable but there are inventors who attempt to bring it in practice. It is the same with this carbonic acid power. A few years ago a pamphlet appeared under the title: "Power without fuel; an investigation of the means by which it may be obtained from natural sources." In this publication, the author attempts to prove the practicability of the plan explained.

On the title page of the pamphlet referred to, we find the following remarkable note: "The right is reserved to patent in the United States any of the plans herein described. None of them will, however, be patented in any European country; they will be free to all who may there choose to employ them." This is simply a bait to European inventors, in order to save our inventor here trouble and expense; giving him, in case the idea should perhaps turn out to be practical, the advantage of the American monopoly, which surely would be worth something if—successful.

To recondense the gas by pressure is of course out of the question, as it would be equivalent to a water wheel pumping up the water which drives it.

We close with the following table of the remarkable effects of heat on water and liquid carbonic acid:

TABLE SHOWING THE COMPARATIVE TEMPERATURES OF STEAM AND CARBONIC ACID, PRODUCING THE SAME PRESSURE.

Pressure in Atmosphere.	Temperature required for this purpose. Of water.	Of liquefied carbonic acid.
100	577	120°
90	566	109°
80	554	98°
70	541	87°
65	534	81°
60	526	75°
55	518	67°
50	509	59°
45	500	52°
42	491	45°
39	482	33°
34	464	23°
29	446	13°
24	428	3°
22	420	—4°
20	410	—8°
18	401	—13°
16	392	—22°
14	380	—27°
12	368	—32°
10	356	—43°
8	338	—53°
6	320	—62°
5	302	—70°
4	288	—78°
3	275	—90°
2½	262	—102°
2	248	—114°
1½	232	—128°
1	212	—148°

Authorities agree as to the steam pressures corresponding with the different temperatures, as contained in this table; in regard to the pressure of the liquefied carbonic acid gas, those for temperatures above 32° Fah. have been taken according to Pelouse, and for the low temperatures, from 32° to —148°, according to the determinations of Faraday.

SULPHITE OF SODA AS A REMEDY FOR SMALL POX.

We publish in another column a very interesting letter upon this subject, the writer of which desires his name to be suppressed, as he does not wish to detract from the force of his statements by creating an impression that he is puffing a nostrum from personal motives. Though personally unknown to us, we have formed a high opinion of the candor of this writer, both from the communication itself and the private letter that accompanied it.

The statements made are in the highest degree remarkable. Small pox has so long been considered an incurable disease, not to be arrested by any human means when once its virus has entered the circulation of those unprotected by vaccination or previous attacks of the same complaint, that the announcement of even a single successful cure will arrest public attention at once.

The remedy named, sulphite of soda, has been growing in favor for some time as an antidote for blood poisons, which act seemingly like ferments; and we have ourselves witnessed apparently happy effects produced by its use in complaints supposed to arise from such poisons. Its value in this class of diseases has been so far demonstrated that it has been made an officinal remedy.

If we are to credit the statements of our correspondent, a most astonishing effect upon the small pox poison was produced by something, which, if it was not the *soda sulphis*, ought to be most earnestly sought. We are not aware that any spontaneous resolution of this terrible disease ever has taken place, of a character that could be mistaken for the cure ascribed to the action of the drug under consideration. The drug produces in proper doses no effects to be feared, and can therefore be made the subject of experiment without danger to patients. Its merits, therefore, as a small pox remedy ought to be at once thoroughly tested, and if it should be found that the cure alluded to was probably an effect of the crude petroleum employed to anoint the body, or the result of a cause unknown, the fact that a cure is alleged should stimulate investigation into the real cause. It is, we believe, very rare that an unfavorable prognosis, based upon the acuteness of pain in the head and back in attacks of small pox, fails to be verified. In the particular case described, these bad symptoms were strongly marked, yet the patient, the next day after the character of the complaint was deemed established by the eruption, was convalescent, and in a few days recovered without the formation of a single pustule.

There is, of course, the possibility that there was a mistake in diagnosis, and that the disease was not really small pox, yet this seems rather improbable. The hope that a cure, for such a scourge as small pox, may be discovered prompts us to call particular attention to the letter of our correspondent; and we most sincerely wish that the supposed efficacy of this simple remedy may be demonstrated to be a verity.

COMPULSORY SAFETY GAGES.---THE STEAMBOAT OWNERS' PROTEST.

A meeting of steamboat owners, held in Philadelphia on Friday, February 2d, resulted in a decided expression of opinion adverse to the action of Congress in rendering it compulsory for them to use certain so-called safety appliances *per se;* but they maintain with much reason that, as they are compelled to assume a responsibility, they should be the judges of the best means to fulfil such obligations.

It is objected that the appliances, in question are not safety appliances in fact, but only so in name, and that the act enforcing their use was passed in the interest of private individuals who hold by patent the monopoly of certain inventions. Mr. Copeland, of New York, a well known and able engineer, pronounces the "safety gages" prescribed in the act as actually perilous to human life, so much so that several steamboat companies have resolved to carry no more passengers till the regulation is abrogated.

The principle of this kind of legislation is wrong, and when adopted always acts in an oppressive manner. It is right that steamboat proprietors should be held responsible for the lives and safety of their passengers; but it is not right that they should be forced to use devices which they and experienced engineers regard as worse than useless. Their responsibility, if they are strictly held to it, will prompt them to select, under the best advice, all that can insure them from incurring damage from accidents to passengers. To arbitrarily select these things for them is to deal a death blow to that healthy competition which is vital to progress. So far from securing safety, such action actually defeats its avowed intent, and increases risk. The action of the companies, as stated above, is wise. Responsibility without free volition is always revolting to reasonable minds; no wonder the steamboat owners reject it. Let the law be either amended or repealed.

THE EFFECT OF SOUND IN BUILDINGS, AS INFLUENCED BY VENTILATION.

We noticed in a recent issue the publication of a work upon this subject.* We now take occasion to review the theory, and its claims to become accepted as science.

It is scarcely necessary to dwell upon the importance of constructing public buildings with reference to the effect of sound. There are so many in which it is difficult both to speak and to hear distinctly, that those who speak and those who listen may find examples without number to enforce the lesson. Any real contribution to our knowledge of the subject, that will enable architects even partially to correct the faults of present construction, would be eagerly embraced by them and find universal application hereafter. Mr. Saeltzer claims to have made such a contribution and to have discovered that, however correct the proportions and form of an auditorium may be with reference to acoustic effect, the result will be failure, unless the ventilation be made to correspond with certain principles, so called, which he lays down in his work.

The following propositions have long been accepted as part of the science of sound, namely: that sound is propagated by fluid, solid, or gaseous media, in waves or pulsations, which extend in all directions from the source of the sound —the sonorous body; that, in general, whatever may be the source of the sound and the number or kind of media that convey it, air forms the best medium by which it reaches the auditory apparatus; that the intensity of sound depends upon the density of the medium in which the sound is generated, and not at all upon the densities of the media which convey it; that the velocity of sound in air is independent of the density of the air; that the velocity of sound in air, at 0° C. or 32° F., is 1,090 feet per second, and that this velocity, will be increased two feet per second for every centigrade degree the temperature is raised.

It is further known that the greater the elasticity of a medium is, the greater the velocity of sound through it, and the greater its density the less will be the velocity of sound traversing it, according to the following law. See Tyndall on "Sound," page 45:

"The velocity is directly proportional to the square root of the elasticity, and inversely proportional to the density of the medium." It follows that in media which, like air, obey Mariotte's law, namely: that their elasticity shall increase in exact proportion to their density, sound will, as above stated

* A Treatise on Acoustics in Connection with Ventilation, by Alexander Saeltzer. New York: D. Van Nostrand, 33 Murray street.

in regard to air, always pass with equal velocities, no matter what their densities may be. This holds good for all gases.

Now, as the density of a medium may be affected by the presence of matters foreign to it, floating in it or intimately mingled with it, while its elasticity may remain unaffected, it follows that the rapidity with which sound is conveyed will be influenced by the presence or absence of such foreign matters. Tyndall, in his first lecture on "Sound" speaks of thunder peals as not penetrating the air to a distance commensurate with their intensity, on account of the non-homogeneous character of the atmosphere attending such storms. In the same lecture he shows how, in the presence of hydrogen which, equally elastic, is less dense than air, the velocity of sound will be much greater than in pure air; and how this velocity is reduced by the presence of carbonic acid, which is denser than air though possessing the same elasticity.

We have here sufficient reason for the assertion that, when the air in an auditorium becomes vitiated by the breathing of many occupants, the increased density affects the velocity of the sound, and the non-homogeneous character of the medium must interfere more or less with the extent to which sound will reach; all this without any new discovery or the enunciation of any new law. Inasmuch as sound is thus impeded, it will be less and less interfered with if the air is kept pure by perfect ventilation. But what is the new discovery?

If we understand the author, who does not make himself very clear in his enunciation of it, it is that carbonic acid is poison to sound as it is poison to life. In other words that sound has some peculiarity that renders air, independent of considerations of density and elasticity, a fitter medium for its transmission than air mingled with watery vapor and carbonic acid. The language used to express this supposed discovery will strike those familiar with acoustics as somewhat peculiar, not to say ludicrous. We will quote some of these propositions:

"The density of the air in those rooms is generally in an unhealthy state, heterogeneous (?) to the nature of sound, and even to health itself." * * * Speaking of the echo in St. Paul's Cathedral, London, the author says: "Now, if we rest upon the assumption that a pure air, genial to sound, guides the path of sound, this mystery is solved at once. Bad air, it is true, becomes much more dense, but the substances of this air are poison to the vitality of the sound, as well as to health, mind, lungs, and voice, and this proves that sound can only carry out its function when well supplied with healthy and congenial air. If you notice the changes of sound in crowded houses, and follow its diminishing state of existence, you will first find its nature often in tolerably good humor, then it becomes delirious, and is placed in a most uncomfortable position, not knowing which way to turn; poison on all sides, ever anxious to do its duty, full of its natural vitality, it becomes disheartened, leaves its first battle field, the pit, next the first gallery, then the second, third etc., and at last, exhausted, looks up as high as possible to gain rest in the strata of warmer and more flexible air, air more congenial to its nature, which is always found at the highest point."

"The theory advanced will also abolish sound boards over pulpits; how is it possible that a sound board, even eight or ten feet square or circular, should cause the sound to descend to the lower strata of air full of poison? never will its nature consent to such unreasonable demands; no, it will, like a bird leaving its open cage to seek its liberty, pass the outlines of the sounding board to rise to a higher sphere, in the very reverse direction to that desired. Forget not that sound is of a nobler character than generally supposed; its requirements are a distinguished treatment, and it will resist every infringement upon its dignity, and hence, not only through science, but even art, is an approach to hearing possible."

"The heat will rise to those parts (the ceiling) and invite the sound to follow, and it does follow with force, and its general diffusion throughout the church is lost."

In another place, the author speaks of sound rays following "the most flexible air," and becoming "isolated and distinct in their field of operation." In still other places, he dwells upon what he calls the "vitality" of sound, as though it were a living entity that could be poisoned by a foul gas.

But enough of quotation. What we have quoted, as well as what we have said, shows that the author thinks, as Josh Billings quaintly says, he has discovered a new truth when he has only stumbled over an old one. That sound is somewhat less audible in ill than in well ventilated rooms has long been known, and the causes have also been known. The fancied cause, assigned by Mr. Saeltzer, is scarcely worth writing a book about, a book that can only influence the opinions of the ill informed, and this by its false teachings.

THE DIFFERENCE BETWEEN BENZOLE AND BENZINE

So much confusion prevails, in consequence of the indiscriminate use of the words benzole and benzine, that it may be proper to state what these substances really are, and in what particulars they differ, and in what they are alike.

In the year 1825, Faraday discovered a peculiar liquid in the holders which at that time were used for conveying illuminating gas to private houses in London. He gave to it the name of bicarburet of hydrogen, and published a pretty full account of its properties. Nearly ten years afterwards, the Berlin chemist Mitscherlich produced the same substance from benzoic acid, and in allusion to its origin he proposed the name benzine. Liebig reprinted Mitscherlich's article in his "Annals," and in a foot note remarks that, as the termination *ine* is too suggestive of strychnine, quinine, etc., bodies with which it has no analogies, it would be better to change the word into benzole, and this he accordingly did. It was thus that the word benzole was first introduced into our language. The French writers adhered to Mitscherlich's original name, and in their dictionaries we find the word benzine, while the English have adopted Liebig's proposition, and speak of benzole. We should have been spared much confusion if Faraday's original name had been retained by all parties.

It will thus be seen that, at the outset, benzole and benzine meant identically the same thing, but after the discovery of petroleum it was observed by chemists that the native rock oil was quite a different substance from the coal tar product of the gas house. The various hydrocarbons which can be distilled from petroleum have a different chemical composition, and vary in specific gravity and properties from the coal tar products. Benzole has a fixed molecular composition; it is a true chemical compound, as much so as alcohol or water; its properties have been fully studied and described, so that on this point no doubts need prevail. On the other hand, the volatile substances which come over during the fractional distillation of petroleum are of a mixed and indefinite character, and it is difficult for chemists to agree upon a definite specific gravity, boiling point, etc. By degrees it has become customary in the United States to call the liquid which has the specific gravity of 62° to 65° Baumé (=0·73) benzine; the lighter hydrocarbons are called naphtha, rhigoline, and chymogene; the latter is condensed by pumps and is used for an ice machine. This class of liquids differ considerably from the true benzole of coal tar; the latter has a specific gravity of 0·85, and freezes at 37° Fah. The light oils of petroleum have never been frozen, and their specific gravity is very low; any product of the distillation of petroleum having so great a specific gravity as 0·85 (that of benzole) would be too thick to burn in a lamp and could only be used for lubricating purposes. The solvent properties of benzole and benzine are analogous, though by no means identical; benzole rapidly dissolves asphaltum while benzine scarcely attacks it; benzole is a better solvent of resins; benzole is far superior to benzine in carbureting air or gas for illuminating purposes. The most marked difference between the two exists in the fact that benzole can be converted by nitric acid into nitro-benzole, and by further treatment into aniline; whereas benzine from petroleum is not thus acted upon, and cannot be employed in the manufacture of aniline colors. Benzine can be readily ignited at a distance, while benzole must have the flame brought a little nearer; although it is volatile at all temperatures, and gives rise to explosive compounds. Benzole costs from six to eight times as much as benzine, according to the state of the market. Nearly all of the benzole of the world is sent to Germany to be there manufactured into aniline, from which are subsequently made the favorite aniline colors. It will thus appear that although benzine and benzole started into life meaning one and the same thing, they have, in the course of time, come to be two widely different substances. Benzole is made from coal tar, benzoic acid, and numerous other bodies, and can be converted into aniline. Benzine comes from petroleum, is very light, cannot be frozen, and cannot be converted into aniline. We find from our foreign exchanges that the English, French, and German writers are beginning to recognize this distinction, and it will be better for all parties to agree upon what boiling point, specific gravity, and chemical formula they will adopt for benzine. Benzole contains about 92·5 per cent carbon and 7·5 per cent hydrogen; benzine is approximately composed of 84 per cent carbon and 16 per cent hydrogen. In America, therefore, benzole and benzine mean different bodies of different origin, and having different uses.

THE ART OF THINKING.

Is thinking an art to be acquired? Are not all men endowed with the power of thought? Is there anything more necessary than for one to close his eyes and let his mind have free course in order to think? To answer these questions, it is necessary to define what is meant by thought. If day-dreaming, that act of mind in which thought roves at random, purposeless and without effort, is thought, then even the idiot thinks in his poor fashion. Then are no rules applicable to this sort of thinking. But much indulgence in this kind of dreamy thinking weakens the mind and begets a mental laziness that is fatal to progress. It benumbs all but the purely animal faculties and instincts. It is, therefore, to be deprecated in the strongest terms. It has proved and will yet prove the ruin of many a promising youth.

The kind of thought worthy the name, which strengthens instead of weakening the mind, is what we mean when we speak of thinking as an art. This kind of thought is the pleasant labor rather than the luxurious ease of the mind. It is only perfect when under complete subjection to will.

The first great thing in learning to think is to bring thought under subjection to will. There has been a great deal said about the importance of gaining mastery over our animal passions, propensities, and emotions. Many an earnest prayer for help to conquer these fleshly lusts has been breathed. The fact is, however, that with minds trained to perfect subservience, the passions can have but little sway. It is unrestrained imagination that kindles the fires of passion. Cool blood generally goes with cool heads.

Too much stress cannot be laid upon the fundamental importance of perfect command over thought. How many a student finds a lack of this power the chief hindrance to progress! How many a page must be re-read, how many a lesson conned over and over to compensate for lapses of thought! In the possession or absence of this power over mind, lies the chief difference between mental strength and mental weakness. Some men think as a child plays with a hammer, striking little blows here, there, anywhere, at any object within reach. The action of a strong mind may be compared to the stonebreaker's sledge hammer, dealing stubborn blows successively upon one spot till the hard rock cracks and yields.

When this command over thought has been acquired through the long exercise of resolute will, the power to arrange ideas and to think systematically will come with it, and no thinking amounts to much unless it is systematic. This, then, may be considered as the second important acquirement in the art of thinking.

The power to classify and arrange ideas in proper order is one that comes more or less slowly to even the best of minds. In proportion as this faculty is strengthened, desultory and wasted effort diminish. When the mind acts, it acts to some purpose, and can begin where it left off without going over the whole ground again to take up the threads of its ratiocinations.

Concentration and system are thus seen to be the chief elements in the art of thinking. To cultivate the first, constant watchfulness to detect the least wandering and the immediate exertion of the will to call back and hold the mind upon the subject under consideration should be vigilantly exercised. To secure the latter, the practice of analyzing and considering the different parts of a subject, first separately and then in their relations to each other, is a discipline to which every young mind should be subjected, and which, we are sorry to say, is very much neglected in the methods of instruction practiced in this country.

JAPANESE NATIVE STEEL.

Mr. G. D. Hamill, superintendant of the Imperial arsenal at Tientsin, China, originally of New York State and now on a visit to this country, called upon us the other day, bringing with him a specimen of what is stated to be native steel found in Japan, several large deposits of which are reported to exist. He states that swords and other articles of cutlery are forged directly from this metal, and that it has been recognized as native steel by every Japanese to whom he has shown it, a circumstance which increases his confidence in the truth of the reports concerning it. The specimen is highly crystalline, resembling somewhat the pig bloom obtained in the Ellershausen process of iron manufacture. If it be true that large and accessible deposits of this material exist in Japan, that country has in its possession an element of wealth the value of which can hardly be estimated.

Though not connected with this subject, we may remark that Mr. Hamill speaks discouragingly of the prospect of future progress in China. This peculiar people is hard to arouse from the influence of the superstitions and prejudices that obstruct civilization; while Japan, inhabited by the same race, and with a religion almost identical in its main features to that of China, is shaking off the sleep of ages, and advancing with marvellous rapidity.

Mr. Hamill speaks of the annual freshet in the region of Tientsin as unusually severe this season. It has flooded the arsenal at that place, and work is suspended. On his return, this gentleman proposes to investigate the subject of the native steel deposits in Japan, and to communicate to us such facts as he may be able to obtain.

SCIENTIFIC AND PRACTICAL INFORMATION.

DESTRUCTION OF SCIENTIFIC COLLECTIONS BY THE CHICAGO FIRE.

Dr. J. W. Foster and Mr. William Stimpson, respectively the President and Secretary of the Chicago Academy, have circulated a report of the losses sustained by their valuable institution in the late conflagration. Among these are some collections of national importance, such as that made by the Audubon club, the entomological collection of Mr. B. D. Walsh, the illustrations of the natural history of Alaska, the Smithsonian *crustacea*, and many others of more or less importance. With characteristic energy and courage, the trustees have announced the intended reconstruction of the buildings, and the recommencement of the publication of the Transactions of the Academy.

The large general collection, illustrating American natural history, was one of the most extensive and complete in this country, and great efforts will be necessary to replace the specimens. Assistance from the museums of Europe, many of which have duplicates, may be relied on; and similar institutions in the United States would do well to help, with all their power, the noble collection of the Chicago Academy, now struggling to regain her position and renown among the *almæ matres* of science in America.

BOILER DEPOSITS.

M. P. Champion publishes the result of his investigation into the causes of a boiler accident, in a sugar manufactory, which was originated by a deposit of carbonate of lime on the interior of the boilers. The utter impenetrability of the carbonate of lime to water caused the burning of the boiler plates. These boilers were fed with water both from an artesian well of great depth and from the condenser of the engines. The water of condensation was free from the carbonate, but the well water showed on boiling a considerable deposit of it. On inspection, fatty matter was discovered in the feed tank; and with a view of investigating its effects, M. Champion prepared a concentrated solution of bicarbonate of lime, and added to it one drop of oil. On boiling, the carbonate was precipitated, and it combined with the fatty matter; and when dried, it was absolutely impenetrable to water, the oil doubtless giving it this resisting power. This is a new light on the subject of boiler incrustation, and deserves the attention of our engineers. Judging from the