covered by the vigilance of the inspectors, and undoubtedly saved much property and many lives. They are as common in American as in English boilers, but are suffered to pass unattended to until explosion occurs.

The London *Mechanics' Magazine* reproaches us in a late issue for publishing a long account of boiler explosions without comment, saying that life is held so cheap in this country that hundreds may be killed through accidents by steam without especial notice. It would take a larger paper than the SCIENTIFIC AMERICAN to record and comment on all the boiler explosions in the United States, and the mere publication of them would do no good.

We have no such admirable concerns as these English boiler insurance companies, but we hope to before long, and in the meanwhile, let every engineer be his own assurer.

NOTES ON NEW DISCOVERIES AND NEW APPLICATIONS OF SCIENCE.

A NEW SODA PROCESS.

A process for obtaining soda from common salt, which, if it should prove successful in practice on the great scale, will be an even greater advance upon the method by which what Dr. Hoffman has well called "the most valuable of all known transformations" is at present effected, than in the Bessemer process upon all previous methods of converting iron into steel, has just been patented by Mr. Walter Weldon. At present, the manufacture of "soda crystals" involves six distinct operations, requiring very extensive and costly plant, and a very large amount of both labor and fuel, besides rather more than an equivalent of that costly reagent, sulphuric acid. The first of these six operations consists in causing sulphuric acid to react upon salt at a high temperature, whereby sulphate of sodium is formed, hydrochloric acid flying off as vapor, and being condensed by means of towers filled with pieces of coke over which water is kept constantly trickling. The hydrochloric acid gas enters at the bottom of these towers, and in its way upward comes into contact with so large a surface of water as to be completely absorbed thereby, forming the aqueous solution of hydrochloric acid which is known in commerce as "muriatic acid," or "spirits of salts." The second operation consists in calcining the sulphate of sodium produced by the first operation with coal and lime, in what are called "balling furnaces," the result being the compound known as "black ash," and usually containing about 24 per cent of carbonate of sodium, 12 per cent of hydrate of sodium, or caustic soda, 2½ per cent of undecomposed salt, 2 per cent of undecomposed sulphate of sodium, and 59 or 60 per cent of "soda waste," consisting mainly of a mixture of oxysulphide of calcium with carbonate of the same base. The third operation consists in carefully lixiviating the "black ash," so as to separate its soluble constituents from its insoluble ones, the results being a solution of mixed hydrate and carbonate of sodium, and that insoluble residue which accumulates in such enormous quantities in the neighborhood of every alkali works, occupying valuable space, and giving off most offensive gases into the atmosphere. The fourth operation consists in boiling down to dryness the solution of mixed hydrate and carbonate of sodium, and the fifth in calcining the resulting "soda ash" with sawdust, in order to convert all the hydrate in it into carbonate. The sixth and last operation consists in dissolving the product as the fifth operation in water, and leaving the solution to stand until the carbonate of sodium in it crystallizes out. When a very pure product is required, the crystals first obtained are again dissolved, and the solution so obtained is left to crystallize as before. These six operations occupy altogether about a fortnight, and if the soda is wanted as bicarbonate, a seventh operation has to be performed, which occupies several days more. By Mr. Weldon's process, however, it is said that a large charge of salt may be converted into bicarbonate of sodium by a single operation, which may be performed in twelve minutes, and this, too, without the use of sulphuric acid, or of anything whatever that is not used over again, except coal, and without the production of a single ounce of any kind of "waste." Mr. Weldon's process is said to consist simply in placing within a suitable vessel, capable of withstanding a moderate amount of internal pressure, an equivalent of magnesia and an equivalent of chloride of sodium, or common salt, together with a small quantity of water, and then pumping in carbonic acid gas, obtained by blowing air through a coal fire. The result is said to be that the carbonic acid converts the magnesia into bicarbonate of magnesium, which can only exist in solution, and that this compound, as fast as it is formed, decomposes an equivalent of the chloride of sodium, forming chloride of magnesium, which is exceedingly soluble, and so remains in solution, and bicarbonate of sodium, which is much less soluble, and therefore falls to the bottom. Bicarbonate of sodium is thus obtained at one operation, extending over less than a quarter of an hour, and without the aid of any more costly reagent than can be obtained by the mere combustion of coal. The bicarbonate thus obtained can be converted into neutral carbonate by the application of a very moderate amount of heat, under the influence of which the bicarbonate gives off one equivalent of carbonic acid, which can of course be used over again. The solution of chloride of magnesium is evaporated to dryness, and the residue then heated to a little below redness, when the hydrochloric acid is all driven off, to be condensed in the usual way, and magnesia is left behind, ready for use over again. The magnesia used in the process thus costs nothing after the first time, and the only materials consumed are salt and coal. It is said that by this process soda may be produced at virtually no cost whatever, the value of the hydro chloric acid obtained exceeding the raw material, fuel, labor, wear and tear, and interest on capital. The quantity of soda now manufactured in this country annually is equivalent to about 700,000 tons of "soda-crystals," the present value of which is about £7 per ton. It follows that Mr. Weldon's process, if it should prove successful on the great scale, would save to this country alone, on its present consumption of soda, something like five millions sterling a year.

BURNING MAGNESIUM IN STEAM.

MM. Deville and Caron have found that magnesium will burn brilliantly in an atmosphere of *steam.* They passed steam through a tube containing magnesium, heated by the flame of a spirit lamp. The magnesium burnt vividly, liberating hydrogen. They tried the same experiment with zinc, and succeeded in making that metal also burn in an atmosphere of steam, but the temperature required was of course very much higher than in the case of magnesium. MM. Deville and Caron have also found that the presence of the feeblest acid will enable magnesium to decompose water, even in the cold. Water containing carbonic acid is decomposed by magnesium with great rapidity.

IMPROVED PROCESS OF SEPARATING SILVER FROM LEAD.

Pattinson's well-known process for separating lead from silver has recently been improved upon on the continent. After having been melted the lead is run into a crystallizing pan, and its surface covered with finely broken coke, upon which a stream of water plays. The mass of metal then receives a circular motion from an agitator, by which the whole is equally moistened and cooled. A crust forms on the top of the mass in about an hour, which encases the fragments of coke. The water is then turned off, the agitation stopped, and the unsolidified lead holding the silver, drawn off from the bottom of the crystallizing pan.

NEW METHOD OF MAKING ICE.

A new method of making ice has been devised by Signor Toselli, who uses a machine, adapted for household purposes, in which compressed steam replaces the ammonia or other agents in ordinary use. The machine consists of two cylinders, in one of which a solution of common salt is placed and heated. When the temperature of the saline solution reaches about 100 deg., the steam is passed into the second cylinder; after evaporating for an hour the connection between the two cylinders is broken, and the one containing the compressed steam is placed in a vessel of cold water.

A SINGULAR OVERSIGHT OF SEVERAL PHILOSOPHERS.

In his recent lecture on "The Relations of Radiant Heat to Chemical Constitution, Color, and Texture," delivered at the Royal Institution and since published in the *Fortnightly Review,* Professor Tyndall gives a curious instance of how small an oversight may entirely destroy the value of otherwise very careful researches, and of "what extreme caution," to use his own phrase, "is essential in the operations of experimental philosophy." Long before he had proved, as he has since done so completely, by varied and most conclusive experiments, that the fact actually is so, Professor Tyndall was convinced that what had already been established, in relation to the phenomena of radiation and absorption, with respect to gases and vapors and the liquids from which vapors are derived—namely that "the acts of radiation and absorption are molecular, depending upon chemical and not upon mechanical conditions," —must necessarily be true also of solids. At the threshold, however, of the researches which he determined to undertake in order to test the soundness of this conviction, he was met by a multitude of facts, obtained by celebrated experimenters, which seemed, at first blush, quite conclusive the other way. Melloni, for example, had found that lampblack and chalk each exhibited precisely the same amount of radiant and absorbent power, and MM. Masson and Courtepee had performed a most elaborate series of experiments on chemical precipitates of various kinds, the results of which went to show that all such bodies possess exactly the same degree of radiative and absorptive energy, and led the experimenters to the conclusion that "where bodies are reduced to an extremely fine state of division, the influence of this state is so powerful as entirely to mask and override whatever influence may be due to chemical constitution." A host of other inquirers had arrived at similar results, but they had all committed a little oversight which utterly vitiated their work. The nature of that oversight Professor Tyndall thus explained:—"I have here," he said, "a metal cube with two of its sides brightly polished. I fill the cube with boiling water and determine the quantity of heat emitted by the two bright surfaces. One of them far transcends the other as a radiator of heat. Both surfaces appear to be metallic. What then, is the cause of the observed difference in their radiative power? Simply this. I have coated one of the surfaces with transparent gum, through which, of course, is seen the metallic luster behind. Now this varnish, though so perfectly transparent to luminous rays, is as opaque as pitch or lampblack to non-luminous ones. It is a powerful emitter of dark rays; it is also a powerful absorber. While, therefore, at the present moment it is copiously pouring forth radiant heat, it does not allow a single ray from the metal behind to pass through it. The varnish, then, and not the metal, is the real radiator. Now, Melloni, Masson, and Courtepee experimented thus: they mixed their powders and precipitates with gum water, and laid them by means of a brush upon the surfaces of a cube like this. True, they saw their red powders red, their white ones white, and their black ones black, but they saw these colors through the coat of varnish which encircled every particle of their powders. When, therefore, they concluded that color had no influence on radiation, no chance had been given to it of asserting its influence; when it was found that all chemical precipitates radiated alike, it was the radiation from a varnish common to them all which showed the observed constancy." In order to show still more conclusively that the case is really thus, Professor Tyndall performed the following further experiment: He took two powders of the same physical appearance, one of them being a compound of mercury and the other a compound of lead. He spread these powders, without varnish of any kind, one on one surface and the other on another surface of such a cube as that used in the experiment already quoted. Filling the cube with boiling water, and determining the amount of the radiation from the two surfaces respectively, he found that the surface covered with one powder emitted only thirty-nine rays while that covered by the other powder emitted seventy-four. He then took a second cube, having two of its surfaces coated with the same powders, but in this instance by the aid of a transparent gum. The radiative power of the surface coated with the one powder was now absolutely the same as that of the surface coated with the other

IMPROVEMENT IN PREPARING CITRIC ACID.

Citric acid, of which the consumption in this country is now very large, is imported chiefly from Sicily, and usually reaches this country as a black fluid, in appearance closely resembling a thin treacle. This black fluid is obtained by inspissating the juice procured by subjecting lemons to pressure, after the rinds of the lemons have been removed, for the sake of their essential oil. The first process to which this black juice is subjected, by the manufacturers here, is that of treatment with chalk, whereby an insoluble citrate of lime is obtained. This citrate of lime, after having been well washed with cold water, is decomposed by sulphuric acid, insoluble sulphate of lime being thus formed and citric acid passing into solution. At this stage the citric acid is still associated with a considerable quantity of coloring matter, of which citric acid is perhaps more tenacious than any other vegetable acid, and accordingly the next step is to remove as much of this as possible by means of animal charcoal. The solution is then evaporated, until, on cooling, it will crystallize. The crystals it then yields are by no means free from coloring matter, but are of a decided brown color, and are therefore re-dissolved, and their solution treated again with animal charcoal, evaporation and crystallization being then repeated as before. Such is the process by which citric acid is usually manufactured; but M. Perret, as has already been announced in these columns, is trying to introduce a process, the first stage of which would be the combination of the citric acid in the lemon juice with magnesia, instead of with lime. The *Bulletin de la Societe Chimique*, of Paris, has just given a detailed account of M. Perret's proposals, the main object of which is to avoid the great loss which so frequently occurs by reason of the inspissated lemon juice becoming so alterated, during its transit from Sicily to England, as to be completely spoilt. This liability of the inspissated juice to spontaneous alteration is shared by citrate of lime, and hence no advantage has been found to attend the plan, which has been many times tried, of treating the lemon juice with lime in Sicily, and so bringing the citric acid to this country, not as inspissated lemon juice, but as the compound which is first formed in the usual process for converting the crude into the commercial acid. M. Perret finds, however, that, by treating lemon juice with magnesia, compounds are obtained which are almost absolutely unalterable, resisting heat and moisture for a very long time without suffering the least injury. He therefore proposes that the lemon juice, immediately on its having been expressed, shall be treated on the spot, with an excess of magnesia—which earth, in the form of carbonate, quite pure enough for use for this purpose, is very abundant in Italy. There is thus formed a perfectly insoluble tri-basic citrate of magnesia, in the form of a very dense granular powder, and if this compound be added to a fresh quantity of lemon juice, heated nearly to the boiling point, there is obtained a solution of bi-basic citrate of magnesia, which, on cooling, yields crystals almost absolutely pure. This bi-basic citrate is of course the most suitable for transport, and will probably before very long be the only form in which we shall import citric acid.

CURIOSITIES OF SOAP BUBBLES.

Mr. J. Broughton, B. Sc., chemical assistant at the Royal Institution, has contributed to the March number of the *Philosophical Magazine*, an account of some very curious optical appearances observed by him in the remarkably permanent soap bubbles which M. Plateau some time ago taught us how to produce by means of a solution of one part of pure oleate of soda in fifty parts of distilled water, mixed with two-thirds of its bulk of pure glycerine. Mr. Broughton states that a bubble blown with this solution and placed on a wire ring under a glass case will frequently, after standing for an hour, exhibit at its upper pole a circular black spot, one-third of an inch in diameter. The black is intense, but it always possesses the property of reflecting a small amount of light. In this position it can easily be examined by means of a lens, which renders visible optical effects of great splendor and interest, and reveals that the film is incessantly in motion. This discovery led Mr. Broughton to devise a simple arrangement for examining a small bubble by means of a powerful compound microscope, the bubble being strongly illuminated by a good condenser, so that the light, after a reflection, might pass through the microscope. With this arrangement he found the film of the bubble to exhibit optical phenomena of the utmost magnificence. The appearances observed in and near the black spot above described were, he says, "of especial splendor. On the black ground moved specks of brilliant yellow and orange, which again contain smaller spots of blue and black, of almost every geometrical form, but always in rapid motion. Many other appearances were observed; among the most common being spots of such regularity that at first sight they produce the effect of structure. Under a high power, these latter were resolved into series of Newton's rings of excessive minuteness. The variety of the phenomena was quite remarkable; but the most commonly occurring effects were those in which the colors red and green prevailed. The motion appeared to be invariable and incessant." Mr. Broughton calculated that the thickness of the film, in the part at which the appearance of a black spot was presented, amounted to about three eight-millionths of an inch.—*Mechanics' Magazine.*.

Cast Steel—Magnesian Crucibles.

Sir:—Last month M. Boussingault presented a note of M. H. Caron to the Academy of Sciences on the air bubbles and blisters in steel, and in which he stated that cast steels in general, and particularly those which are termed in commerce soft, because the tempering modifies very little their hardness, are subject to contain bubbles. In order to avoid these, or at least to lessen the number and dimensions, the general practice is, as soon as the jet is run, to weigh the ingot with a piece of cast iron, fitting exactly into the ingot mold. The effect of this piece is to cool the surface in fusion which it touches, and thereby prevent the gases from escaping, and producing numerous cavities, which would deteriorate the value of the steel cast without this precaution.

These blisters are of two kinds. One sort, with metallic and iron-colored luster inside, seem to have been produced by a gas incapable of oxydizing the metal; this is the most numerous. The other presenting to the eye the varied colors of iron or of steel heated in the presence of an oxydizing gas, is much more seldom met with than the first, and is only met with at the surface of the ingots. It is certain that hydrogen, carbonic oxide gas, nitrogen, or a mixture of these gases, are the only possible causes of these blisters. Have these gases originated from the atmosphere of the furnace? or have they been absorbed in nature by the metal in fusion? If they do not proceed directly, and without transformation, from the ambient gases, how and why does it happen that they are developed just at the moment of the solidification of the metal? Lastly, how are these bubbles to be avoided? Such are the questions which M. Caron proposed to himself, the answers to which he has endeavored to furnish by direct experiment.

Steel, cast in a crucible of refractory earthenware, and left to cool slowly, is always full of cavities lined with crystals; often, even, when the gases of the furnace have penetrated in sufficient quantity into the crucible, the ingot is found to be surmounted by a metallic and cavernous efflorescence, occupying a considerable volume. This is never seen in the case of iron.

These two fusions of steel and of iron having been made under the same circumstances, the two metals have had to be exposed to the influence of the same gases composing the atmosphere of the furnace. There are, therefore, only two hypotheses now possible:—1. That the direct absorption of the hydrogen and carbonic oxide gas of the furnace by the metal in fusion may lead us to suppose that steel possesses the property of absorbing these gases, and that iron does not. 2. That, not admitting this direct absorption as demonstrated satisfactorily, we may be of opinion that the bubbles proceed from a disengagement of gases, caused by the action of the carbon (which distinguishes iron from steel) upon some substance mingled with, or dissolved in, the steel.

In order to determine which of these two hypotheses is the right one, M. Caron considered that it would be sufficient to melt steel in a porcelain tube, traversed by a current of hydrogen or carbonic oxide gas, and to ascertain the presence or absence of bubbles. When the cup in which the steel is placed is of porcelain, no efflorescence is perceived after the cooling of the molten metal; but the surface of the ingot which touches the porcelain is covered with cavities similar to those remarked in steel melted in a crucible. This being the case, M. Caron tried to know whether the nature of the vessel in which the fusion took place did not exert some influence on the result obtained, so he substituted for the porcelain cup a vessel of magnesia, and afterwards one of quicklime (both these cups being separated from the porcelain tube by a layer of platinum); he then obtained ingots perfectly free from cavities, efflorescence, or blisters.

These experiments demonstrate that it is not the hydrogen nor the carbonic oxide gas, absorbed by the iron or steel in fusion, which produces the blisters; they show, moreover, that the bubbles proceed from two causes, which contribute equally to the formation of carbonic acid gas. These two causes are, first and foremost, the oxide of iron produced by the oxidizing atmosphere of the furnace; next the decomposition, by the carbon, of the steel, of the silicate of iron formed at the contact with the silica of the crucibles. M. Caron states that it is very easy to obtain, by compression, crucibles of magneisa very resisting and inflexible. They have the advantage over chalk crucibles of being able to be preserved fo a very long time without alteration. M. Regnault states that Tillover has operated successfully at the Sevres manufactory in fabricating magnesia crucibles. He compresses the magnesia by means of a lever-beam, and so infusible are they that platinum may be readily melted in them.—*London Mining Journal.* C. H. D.

NEW PUBLICATIONS.

Text Book of Chemistry—For the Use of Schools and Colleges. By H. Draper, M. D., Professor Adjunct of Chemistry in the New York University. Harper & Bros., Publishers, New York.

This book contains over 500 pages and is embellished with more than 300 engravings, and embodies the valuable parts published on the same subject in 1846, by Dr. Draper's father. This volume is brought up to the present time, and a free use has been made of all the most recent authorities, both in the English and other languages. The subjects are all presented in plain language; and as a text book for schools or for those who desire to obtain a knowledge of the elemental principles of chemistry, we do not think it has a superior. The author appears to be a thorough master of the subject.

PATENT-OFFICE DECISIONS.

Application for a patent for improvements in Cartridge Cases.

The Board, by Elisha Foote—These cartridges are provided with a nipple in the base, adapted to the use of ordinary percussion caps, and to prevent accidental explosions, it is inserted entirely within the cylinder in what is termed the safety chamber. In this, however, the applicant was found to have been anticipated by several previous devices, and thereupon, by amendents, he has limited his claims to the peculiarities of his construction.

In the previous devices the nipple was placed at the center of the base, so that the cap would be struck by the hammer in every position of the cartridge in the barrel. In the applicant's it is placed at one side, and can be struck by the hammer only in one position, to insure which projections are made on each side of the cartridge to fit corresponding slots in the barrel. For these variations the patent is claimed.

We are unable to perceive any advantages from this arrangement. It seems to be going from simplicity to complication—to increase rather than diminish expenses, and to require care and precision in use beyond what was necessary in previous devices. Patents are intended to be a reward for improvements—something must be given to the public in return for the privileges bestowed. It is a great mistake to suppose that every different arrangement of devices is patentable. Changes of form merely, without new results, do not come within the object and provisions of the patent laws. Inventions, even, are made patentable (Act of 1836, Sec. 7), only when deemed "sufficiently useful and important."

The decision of the Examiner in charge is affirmed.

A Dr. Sace has proposed a plan of utilizing the marshes of France, which at present produce nothing but fever and ague. M. Sace proposes sowing them with Canada rice, and turning down a lot of beavers; both the plant and the animal can live in any climate —both would be equally useful, and one would support the other. At present large sums are annually sent from France to America to purchase beaver skins, which might thus become articles of home production.