leather: Wash in lukewarm water with a little soap, use a wooden-backed brush with short bristles, as used for washing horses; scrape off the dirt and outer skin with a blunt knife. Keep on this treatment till the hide is half saturated; then twist, turn and roll the leather with both hands till all the pores are open, and work them well; if you see small cracks on the surface, good; if the leather splits, it is rotten. While the leather is damp, begin to rub in the oil with a brush as before described; use a little oil at a time and apply four or five times, and work the leather well with the hands after oiling. Set it in a hot sun for half an hour, and then put in a damp place with a wet sack over it. To keep off rats, invert a wooden box over the heap. Oil and work again the next day, and for many days after; and then compare with an old pump valve, and observe the difference."

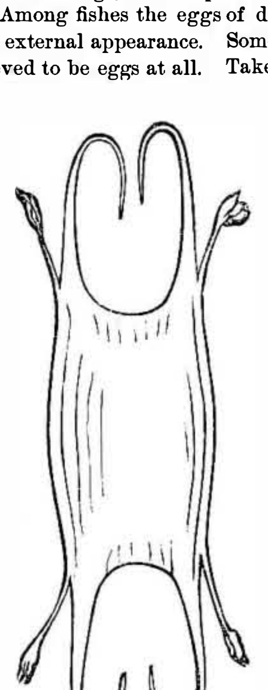
THE WONDERS OF THE EGG.

Professor Agassiz recently delivered a most interesting lecture at the Museum of Comparative Zöology, Harvard University. It was profusely illustrated by specimens from the shelves of the museum. We take the following report from the New York *Tribune*:

The Professor said: The formation and growth of the egg and its fecundation prior to the formation of the new being are among the most mysterious processes of the organic world. The eggs laid by different kinds of animals are themselves so various in size, form and appearance that it is difficult to believe they are all one and the same thing. Look at this huge egg, for which a man's hat would be too small a cup. It is the egg of an extinct bird found at Madagascar (the epiornis), the largest bird's egg known. Compare it with the egg of the humming bird, smaller than a hazel nut, scarcely larger than a small pea. In form and general aspect the difference, even among birds' eggs, is endless. Some are elongated, some are spherical, some are dull on the surface, some are polished, some are dark, others gray or white, others very bright. The number known is large. Ornithologists are acquainted with about 5,000 different kinds of birds' eggs. While they differ in detail, the general pattern of birds' eggs seems the same. The outside shell is brittle, and within there is a lining membrane covering the white, while in the center is the yolk, differing in dimensions in different species of birds as much as the eggs themselves. Quite otherwise, seemingly, is the egg of the mammalia. Those which are developed are never laid. As eggs they are microscopically small, and they undergo all their transformations within the mother. Yet their structure at some time or other, in an early stage of their growth, is the same as that of the egg in all other classes of animals.

Among reptiles the eggs exhibit great variety. The eggs of alligators are elongated, almost cylindrical, evenly rounded at both ends, and about the size of an ordinary duck's egg. The eggs of the sea turtle are about as large as a small apple, rounded, and have a flexible shell. Those of the snapping turtle are much smaller, but also rounded. Those of our terrapins are oblong, as are also those of lizards. Snakes' eggs are oblong and sometimes cylindrical in shape. Frogs and toads lay numbers of small eggs. They are dropped in the water like fish spawn, in large clusters or strings. The Surinam toad (pipa) carries her eggs soldered together like a honeycomb on her back. The alytus carries them between its legs, rolled up in a bunch.

Among fishes the eggs of different kinds differ amazingly in external appearance. Some of them would hardly be believed to be eggs at all. Take, for instance, the skate's egg. It looks like a flattened blackish leather bag, with four horns or handles at the four corners. The yolk in such an egg is the size of a walnut, or larger or smaller according to the species. All skates and sharks have eggs like these, though not all lay them, the young in many instances undergoing their development within the mother. The chimera has a still more curious egg. It is like a leaf made out of parchment. In the center is an oblong cavity containing the yolk.

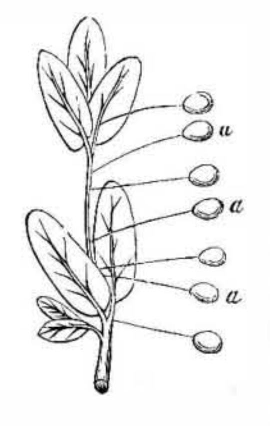


THE SKATE'S EGG.

The number of eggs laid by animals belonging to the same class is again singularly different. The eggs (or, as we call them, the spawn) of some fish are exceedingly small and are laid in large masses. The spawn of a single herring is made up of hundreds of thousands of eggs. Other fishes lay only a few dozen at a time, and in some kinds they are of considerable size. Some fishes let their spawn fall into the water; others make nests for their eggs, and others carry them until the young are fully developed. Some catfish carry their young in the mouth till they can provide for themselves. Certain fishes carry their young along the gills and they go in and out at will through the gill cavity. Some carry them attached to the surface of the belly or under the tail, and among the pipe fishes, strange to say, this office devolves upon the males (syngnathus).

In the higher vertebrates the young are less numerous. A great many mammalia bear but one at a time.

Insect eggs are, as a general thing, too small to be perceptible at a distance. The egg of a day butterfly is attached by a string to a twig. Those of certain water insects are kept floating by string-like appendages. The eggs of the pearl wing fly are fastened by the frailest possible threads to the margins of leaves [a, a, a, in diagram]. Those of the seventeen year locust lie side by side in rows in the branches of trees. Those of the so-called soothsayer (mantis) are deposited in large, elongated clusters which might be mistaken for a caterpillar at rest.

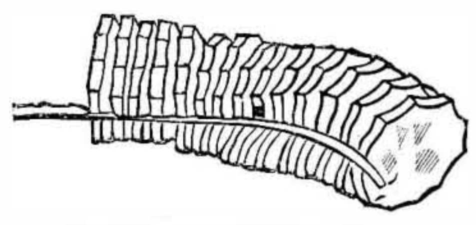


THE EGGS OF THE PEARL WING FLY (CHRYSOPA).

In the two other classes of articulates, in the crustacea, (crabs, lobsters, shrimps, and the like), and in worms, the eggs vary less than in insects. In the crustacea they are always small, and are carried under the tail.

In the type of mollusks we find great variety among the eggs. There are mollusk eggs which might easily be mistaken for birds' eggs, some of which are larger than most birds' eggs. At first sight one would be quite sure that the egg of a bulimus was a humming bird's egg. Others again are very different from the eggs of any animal belonging to other types.

Here, for instance, is the long string of



EGG CASES LAID BY THE PYRULA,

every such case containing from 15 to 20 eggs, and sometimes more. Others lay clusters of eggs surrounded by an egg case. The periwinkle lays an immense mass of eggs, larger than the shell itself. Here are what are called sand saucers formed by the eggs laid by the natica. The mass of eggs is pressed out between the shell and the soft parts of the animal, which at the moment are so expanded and protruded as to cover the whole surface of the shell. The mass of eggs thus laid is molded as it were to the external form of the shell; and being laid while the animal is buried in the sand, the sand accumulates upon them and forms the disk like shape. If you cut such a so-called sand saucer across, you will find minute eggs the size of a pin's head laid side by side throughout it, every egg containing, perhaps, from six to seven individuals.

Among bivalves there is not so great a diversity of eggs as among univalves. They are usually small, like spawn, and generally retained by the mother.

THE CONFIGURATION AND DIMENSIONS OF BLAST FURNACES.

We extract the following description and illustrations from Stölzel's work on metallurgy:

In building a blast furnace, it is usual to make the exterior either in the form of a quadrilateral pyramid, or a truncated cone; sometimes, however, a conical superstructure is placed upon a pyramidal base. The shell, in many furnaces, rests on four corner pillars, the tops of which are connected by arches, or the pillars are surmounted by iron girders set in form of stairs. In other cases, the shell is supported by a ring wall and boshes, with a cast iron crest resting on pillars. In this latter arrangement, commonly used in Scotland, the hearth is free and accessible in all parts. Sometimes the construction is varied by setting only the ring wall and boshes on pillars, the outer shell resting on a solid wall. In the truncated conical furnaces it is often customary, especially in England, to use a sheet iron mantle instead of one of masonry; the mantle then consists of rings or riveted iron plates, and is lined with stone.

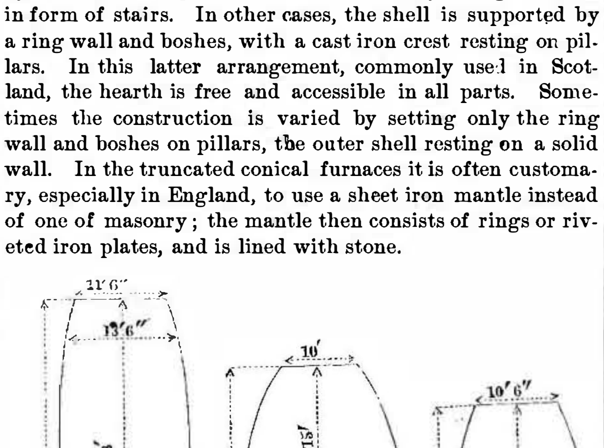


Fig. 1. Capacity 9,300 cubic feet, Schneider, Hannay & Co., Barrow-in-Furness, Lancashire. Fig. 2. Capacity 8,000 cubic feet. Ebbw Vale, Wales. Fig. 3. Capacity 6,160 cubic feet. Dowlais, Wales.

But the variations in the form of the interior of the blast furnaces are still more important. The differences which exist in this may be seen in Figs. 1 to 12, in which the sections of various blast furnaces are represented.

Either these changes are made to suit the different processes and the diverse natures of the raw materials, or else the different forms have been brought about by the absence of any well known rules. In some instances the latter deficiency is easily seen; and so various are the forms employed, that we cannot attach much importance to uniformity in these structures.

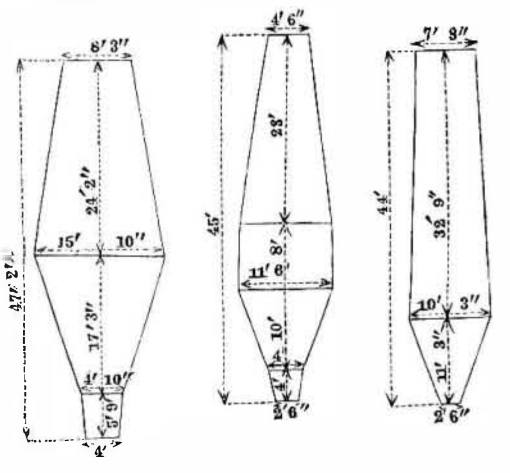


Fig. 4. Capacity 4,540 cubic feet. Nithsdale, Scotland. Fig. 5. Capacity 2,600 cubic feet. Madeley Wood, Shropshire, Eng. Fig. 6. Capacity 2,300 cubic feet. Low Moor, Yorkshire, England.

The hight of the shaft is, in charcoal furnaces, from thirty to forty feet, and in stone coal and coke furnaces, from forty to fifty feet, rarely more or less. Higher shafts are especially suitable for fuel (with the exception of anthracite) requiring a strong blast, for uncalcined and refractory ores and for unburned limestone; this is owing to the fact that the heat is better utilized in a tall furnace. Yet there is a certain limit to the hight, because (1) the materials forming the lower courses would be weakened by the superincumbent weight, and (2) on account of the resistance which a high column offers to the passage of blast and gases, a sort of

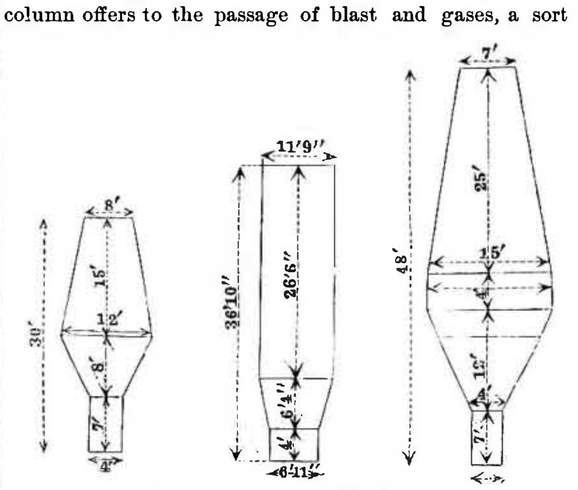


Fig. 7. Capacity 3,440 cubic feet. Muirkirk, Scotland. Fig. 8. Capacity 4,211 cubic feet. Königshütte, Upper Silesia. Fig. 9. Capacity 1,720 cubic feet. Watney's anthracite furnace, South Wales.

back pressure. Hence, in order to increase the capacity of a furnace, it is preferable to increase the width rather than the hight. The diameter of the furnace at its belly, or widest part, is from one fifth to one third of the entire hight of the stack; in charcoal furnaces it is from five to eight feet, in coke furnaces, from ten to sixteen feet, or even more; and the belly is set higher or deeper in the length of the shaft according to the time which the materials require to be subjected to heat before smelting, and according to the pressure of the blast. In recent times, the belly or largest part has often been constructed in a cylindrical form, or in a slightly bent curve.

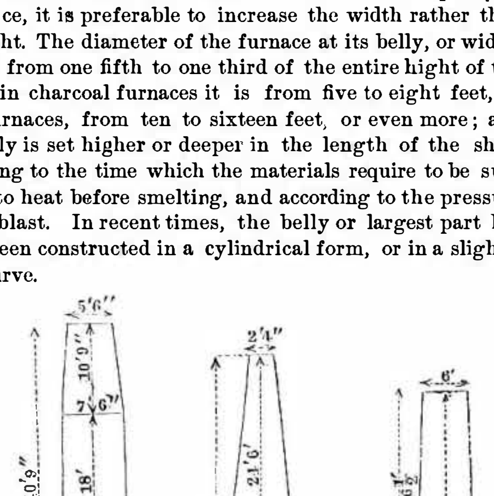


Fig. 10. Capacity 1,384 cubic feet. Charcoal blast furnace, Kärns, Sweden. Fig. 11. Capacity 1,000 cubic feet. Charcoal blast furnace, Eisenerz, Styria. Fig. 12. Capacity 1,067 cubic feet. Charcoal furnace, Rothehütte, Hartz Mountains.

The diameter of the stack at the top varies from one third to three fourths of the diameter at the belly. In small charcoal furnaces, it is often not more than three feet, while in coke furnaces, it may be twelve feet or more. In general, it is considered advantageous to use wider tops than was formerly the practice; in the Hartz and in Sweden, the change has done excellent service. By narrowing the tops, the rate of outflow, as well as the tension, of the ascending gases is increased, and the heat is also drawn more to the point of exit; in consequence thereof, a part of the fuel is consumed where it is entirely wasted, and ores as well as fuel are not sufficiently prepared. This is especially objectionable where refractory unroasted ores, poor fuel, and crude fluxes are used. Another drawback is that the narrow exits facilitate unequal sinking of the charge and prevent a quick combustion. Baranzoff, Truran, and more recently Rachette, have widened the top of the stacks so much that the dimensions of the furnace, contrary to the form generally in use, gradually increase from the base upwards; but how this extraordinary construction can be of use is a question which has called forth various views, and which can only finally be settled by practical experience.

For easily fusible charges and the manufacture of a white pig iron, free from silicon, Tunner still considers narrow tops, narrow belly, and a wide hearth, necessary, that the gases may reach the tension and temperature necessary for the reduction of the ores. It is evident that the capacity and daily production of blast furnaces must vary, with their dimensions and forms, from each other. For instance, there are small charcoal furnaces with a daily production of scarcely two and a half tuns of gray pig iron, while the coke furnace of A. Schneider, at Barrow in Furness (Fig. 1.), turns out daily as much as ninety-seven and a half tuns, the maximum thus far obtained.

Boshes deviating at wide angles are to be avoided. Although facilitating the carbonization of the iron by retarding the descent of the intervals towards the hearth, it often occurs that a part of the charge remains on the boshes, unaffected by the heat; but with steep boshes the charges sink more rapidly and uniformly, and smelt sooner, especially if coke and a hot blast are employed.

The construction of the hearth, or that part of the furnace in which the carbonized iron is brought to a liquid, is of essential importance, as on it depends the quantity as well as the quality of the pig iron produced; and it must be adapted to the nature of the materials as well as to the blast, and in proper proportion to the capacity of the boshes. Narrow and high hearths concentrate the heat more than wide ones, hence they are especially used in smelting gray cast iron and difficultly reducible ores, and with light coal and weak blast; while wide and low hearths are found to be more suitable for white pig, readily fusible and easily reducible ores, dense coal, and strong blast. As the charges fall more rapidly in the latter, they are used wherever a large production is needed, the temperature necessary for the production of gray pig being brought about by a hot and concentrated blast, and by the use of a greater quantity of fuel, in case the ores need the addition. The hearth is generally of a circular, square, or oblong section, and it widens towards the top; and, as already mentioned, it is either free of access or is built solid, in which case only the four arches leading to the tweer and the side where the door is remain open. In the first instance, the hearth is easily accessible in case of repairs, and it can be cooled by the air, which is desirable, for it has, of all the parts of the furnace, to endure the greatest heat, and hence is most subject to destruction. Cooling is sometimes effected by surrounding its sides as well as the boshes with hollow iron water boxes, through which a current of water circulates; sometimes the sides are kept merely moist on the outside by slowly dripping water. However, such a protection requires a larger quantity of coal for maintaining the necessary temperature in the interior of the furnace, and is likely to cause explosion if the water, by accident, penetrate through into the melting mass.

In many furnaces, especially in those for making white pig, a hearth is not used; and other conditions being equal, the temperature in the melting zone is thus decreased; the boshes are here made steeper and the belly higher up the shaft. We find this construction especially in many blast furnaces in Wales and Scotland, using ores found in the coal formation; and sometimes also in the furnaces of Styria, which use readily fusible spathic ores and brown iron ores.

TO TRAIN FUCHSIAS.—When a slip has grown six or eight inches high, nip out the top down to the last set of leaves; it will then throw out branches on each side. Let these grow eight or ten inches; then nip them out as before; the tops of each branch, when grown the same hight as the others, nip out again; then procure a stick the size of your finger, eighteen inches in length; take a hoop skirt wire, twine back and forth alternately, through holes made in the stick equal distances apart; place this firmly in the pot back of the plant, tie the branches to it, and you will have, when in flower, a beautiful and very graceful plant.

AMMONIA FOR VERBENAS.—The sulphate of ammonia is an excellent manurial liquid to apply to verbenas and other flowers, giving to the foliage a dark green, luxuriant and healthy appearance. It is economical, clean and easily applied. Prepare it in the evening before using, by dissolving one ounce of ammonia in two gallons of water. It may be applied with safety about once a week.

A FISH, 3½ feet long, with a slender eel-like body and a large head with a mouth like a crocodile's, has been brought to San Francisco, says the *Mining and Scientific Press*. The teeth are sharp and transparent, sloping backwards from the jaws. Immediately back of the head commences a large wing-like fin, about six inches high when erect, which runs the length of the back. The fish was found dead at Humboldt Bay, and is preserved in alcohol.

AN old lady said to her sons: "Boys, don't you ever spekerlate or wait for something to turn up. You might as well go and sit down on a stone in the middle of a medder, with a pail twixt your legs, and wait for a cow to back up to you to be milked."

Correspondence.

Working Steam Expansively.

To the Editor of the Scientific American:

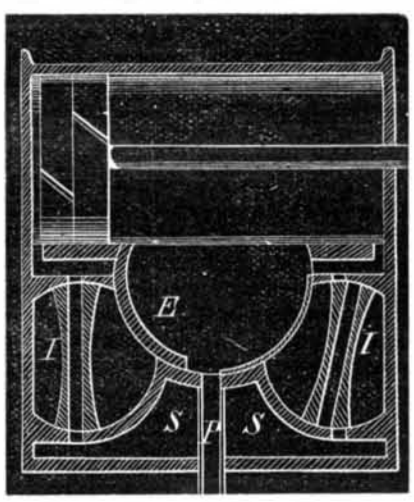
I have a few ideas in regard to steam engine economy which I wish to be made public through the columns of your valuable paper.

There are but few, if any, steam engines in use that utilize the full expansive force of the steam; nearly all use steam expansively to some extent, but in most cases there is but a small percentage of its force utilized. For the purpose of showing the great waste of power in nearly all of our machine shops, manufacturing establishments, saw mills, etc., I submit the following table, showing the comparative power of engines using the same amount of steam, steam pressure at 100 lbs. and an engine cutting off at full stroke being taken as giving a unit of power:

Cutting off	at	full stroke	will	develope	1	unit	of force.
"	"	7/8	"	"	1·13	"	"
"	"	3/4	"	"	1·28	"	"
"	"	2/3	"	"	1·40	"	"
"	"	1/2	"	"	1·71	"	"
"	"	1/3	"	"	2·23	"	"
"	"	1/4	"	"	2·71	"	"
"	"	1/6	"	"	3·60	"	"
"	"	1/8	"	"	4·48	"	"

An engine cutting off at less than one eighth of its stroke will not utilize as much force as an engine cutting off at one eighth of its stroke, as steam at 100 lbs. pressure, expanded into more than eight times its volume, will be at less than atmospheric pressure.

In a common slide valve engine, the pressure on the valve and the imperfection of the exhaust render it impracticable to cut off at less than two thirds or three quarters of the stroke. Now, if we can have the induction and exhaust valves independent of each other, we may change the cut-off without deranging the exhaust. The engraving represents a vertical section of the interior working parts of such an engine. I I represent the induction valves, and E the escape. The valve at the left being open, the steam passes from the steam chest, S S, through the valve to the cylinder, and the escape, being open on the other side, allows the steam to pass from the other end of the cylinder, through the valve, E, and the escape pipe, P. The valves move in orbits, and



hence the motions are rotary. The valves are moved, but the width of the port thus reduces the friction. There is but a portion of the valve (equal to the area of the port) exposed to steam pressure, and this is partially balanced by the pressure on the same amount of surface from the cylinder. Now if by a certain mechanism the induction valves may be made to open and cut off at one eighth, one sixth, one quarter, or one half of the stroke, and the escape remain open during the whole of the stroke, would there not be a great increase of power? I have a mechanism by which these ends may be accomplished. I have written this for the purpose of eliciting the criticism of some one of experience, as my knowledge is wholly theoretical. C. H. C.

REMARKS BY THE EDITOR:—Our correspondent has fallen into an error, which has already led to the fruitless expenditure of vast amounts of time, thought, and money. Although his statement of the relative powers developed by steam of the different degrees of expansion noted is, in the abstract, correct, he would find (were he to test the matter experimentally, as has already been done by others) that in practice the anticipated economy never follows the use of highly expanded steam. Losses by radiation of heat, by leakage, and above all by internal condensation, become far greater in proportion to the quantity of steam used, where great expansion occurs, than with steam "following" further, and these losses do not enter into his account. They are so great, finally, that there is soon reached a limit, in ordinary engines, beyond which no gain results from further expansion. Chief Engineer Isherwood, of the U. S. Navy, in whose ability and accuracy as an experimenter we have the greatest confidence, although differing widely with him in our deductions from his recorded results, found that the maximum economy, in the ordinary marine engine, occurred with the cut-off at about four tenths the length of stroke, and this conclusion was confirmed by later experiment. With jacketed cylinders, higher piston speed, and higher steam pressure, a shorter cut-off is allowable, and great economy is realized, as is seen in the "compound" or "double cylinder" engines now so rapidly coming into use.

Our correspondent, were he to build his engine, would therefore be likely to find himself sadly disappointed in the result expected from a short cut-off. Again, the best engines in the market, if of sufficiently large size to justify the expense of such valve gear, are now invariably provided with independent steam and exhaust valves, and are capable of expanding to any desired extent. In first class engines, the point of cut-off is adjusted by the governor, a requisite which has escaped the attention of our correspondent.

The most intelligent, practical, and best educated engineers in the country have been studying the use of steam for many years, and are now far ahead of our correspondent in both theory and practice. They understand the requisites of economy and the methods of securing it, and, as a consequence, the American stationary engine leads the world, and is copied by all the most enterprising builders of Great Britain and the continent of Europe.

A Pennsylvania Gas Well.

To the Editor of the Scientific American:

I wish to give you some description of a gas well here in the Butler county oil fields. It is situated about two miles from the village of Fairview, and was drilled last June in search of oil. It was put to the depth of 1,200 feet and was abandoned on account of a strong flow of salt water and gas; so much came out that the boiler that made the steam had to be moved to a distance of 25 rods. After the well had been abandoned about two months, the pressure of gas became so strong that it forced the water entirely out of the hole, and last fall a company was formed here to utilize the gas, which was done by bringing it through 3½ inch pipe here to Fairview and thence to Petrolia, three miles from Fairview. The gas will be used to light and warm both places. I visited the well in company with two other gentlemen; the gas is taken out of the well through 3 inch pipes into an old fashioned two flued steam boiler; upon the boiler is placed a steam gage which indicates a steady pressure of 80 lbs. The boiler has also upon it two safety valves steadily blowing off, also a cock in the boiler of one inch in diameter open all the time. This well has also an escape through a 6 inch pipe, the noise of the escaping through which can be heard readily for a distance of two miles. I was told by a gentleman here that the main discharge was closed for a second of time, when the indicator on the steam gage instantly flew around to its utmost capacity, which is 250 pounds. This well is a great curiosity to the neighborhood. W. E. P.

Lens Fires.

To the Editor of the Scientific American:

On page 193 of the current volume of the SCIENTIFIC AMERICAN, appears an article on lens fires, which reminds me of an affair that was reported in the daily papers eighteen or twenty years ago; and believing the subject is entitled to more consideration than most people imagine, I send you the substance of the event alluded to.

A legal gentleman, in one of our large eastern cities, upon entering his office one summer morning, found the loose papers on his table just starting into a light flame, which surprised him greatly, as there was no fire in the room at that time, neither was it apparent how they could have ignited from any external cause, the windows being closed. This happened several mornings in succession, but one day he arrived at his office earlier than usual and succeeded in detecting the origin of the fire. Sitting at his table, he felt a burning sensation upon one of his hands, which gradually increased until it became insupportable; and on looking at the window through which the sun was shining, he noticed that one of the panes of glass had a bubble or flaw in it which served to concentrate the rays of light in the same manner as a burning glass, and with sufficient power to ignite paper in a few minutes. The dangerous pane was at once removed, and with it the cause of a "mysterious conflagration."

J. H. L.

Sugar Manufacture in the Sandwich Islands.

To the Editor of the Scientific American:

The sugar planters of the Sandwich islands have had, and many of them are now having, a hard struggle for life. Many of us had had no experience in the sugar business when we commenced our plantations; and what little knowledge we have now has been attained only at great expense and loss of time and material. I have received many valuable hints from your paper, and would like to see more upon the subject of plantation sugar making. My plant consists of 500 gallon clarifiers, precipitators, an open train, a steam leach and a vacuum pan. I want to know how best to apply sulphurous acid gas to the cane juice in order to check fermentation and bleach the sugar. Also, whether sulphate of baryta is used for precipitating the dirt in the cane juice? If so, how should it be applied, and in what quantity?

S. L. AUSTIN.

Onomea Plantation, District of Hilo, Hawaii, Sandwich Islands.

Low Water in Steam Boilers.

To the Editor of the Scientific American:

Reading the many articles in your paper on boiler explosions, and especially on the low water question, I venture to give my views and experience which, perhaps, may benefit some of your readers. I once attempted to raise steam and pump up a two flue 40 inch boiler with water only just up to bottom of the flues; but before I got 15 lbs. steam, I heard a report like a pistol shot; and on looking under the boiler, I saw the third sheet cracked from about two inches below the water, running up about a foot, and the water squirting out like a saw blade. The sheets were not overheated, for I had fired very slowly and carefully. I claim that it was caused by the expansion of the flues. I think that a boiler,