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(Illustrations are indicated by an asterisk.)

INEXPLICABLE BOILER EXPLOSIONS.

We have before us an exchange which gives an account of a boiler explosion, and ends, as usual, with this remark: "Everything was in good order about this boiler and it was considered one of the strongest in the place." To this the impertinent skeptic might reply, how could it be in good order when it burst! And if this was the strongest, how is it that the weak ones are still in existence?

It would be curious to know how many boilers in use at the present day are inspected. *Inspected*, not smelled of, superficially criticised, or jocularly allowed to be "a pretty good boiler." How many inspectors are there who take off their coats, roll up their sleeves and go in where they can get in, crawl where they cannot stand, and lie down, doubled up, where they cannot crawl, in order to see what the actual state of things is—the real condition of the boiler? We venture to say there are but few boilers thoroughly inspected in this country, and the frequent recurrence of disaster shows that stringent examination is necessary. It is almost useless to look at a boiler after an explosion to see the cause; it ought to have been examined and predicted before, and the proprietor whose works are destroyed is himself to blame for the disaster which, in most cases, he might have prevented by care.

In England they have an association of sensible men who examine boilers and insure them against explosion for a small premium, and the system has been found to work admirably. At last accounts neither president nor subordinate had run away with the funds. We have no such system in this country, but we might have, with a little organization and energy; good results would be sure to follow.

We should thus, doubtless, be spared the pain of reading such an avowal as a police inspector of boilers made recently. "I examine the engines and give them certificates," quoth he, "but I am not a practical engineer myself."

On board ship the chief engineer is the inspector, and that he does his duty as a representative of his class is to be inferred from the rarity of accidents at sea from the explosion of boilers. Every explosion so caused—that is, by neglect of inspecting the boiler—can be counted on the fingers. With the commonest prudence most of the boiler explosions might be prevented.

MISS FANNY R. PURVES, of Philadelphia, proposes, as an improvement in school desks, the setting of a slate in the lid or cover of the desk, flush with the top of the desk.

GREAT IMPROVEMENT IN SUGAR MAKING.

The two properties which most broadly distinguish grape sugar from cane sugar are the inferior sweetness of grape sugar and its disposition to absorb moisture. Cane sugar is very easily converted into grape sugar, but it is not known that the reversed process has ever taken place. When juice is expressed from the sugar cane its sugar always contains two per cent or more of grape sugar—the proportion being greater if the growing canes have been bruised or wounded. In the process of evaporation the proportion is generally increased to at least 15 per cent, and every pound of grape sugar prevents the separation of a pound of cane sugar, thus causing the loss of 30 per cent. This goes mostly into the molasses.

The proportion of cane sugar converted into grape in the evaporation depends mainly on the length of the process, hence the great economy of rapid evaporation.

Grape sugar may be boiled down dry, but if exposed to the air it gradually absorbs moisture, and becomes clammy or sticky. This property of maple sugar is mainly due to the large proportion of grape sugar which it contains—this having been formed in the process of evaporation. In India and in the interior of Cuba there is a similar article of sugar made from cane—the whole mass having been boiled down to dryness instead of separating the cane sugar by granulation in the usual way. The principal difficulty with the sorghum in this country is the large proportion converted into grape sugar in the process of evaporation.

We are informed by a very intelligent sugar manufacturer from Cuba, that an improvement has recently been introduced by which the formation of grape sugar in the process of boiling is almost wholly prevented; it is simply the introduction of superphosphate of lime into the cane juice before boiling. If this is as effectual as is represented, it must be of incalculable value, not only to the sugar growers of Cuba and Louisiana, but also to the refiners of this city, and to the growers of sorghum and the manufacturers of maple sugar. The author of the improvement is Mr. Reed, an Englishman.

The several kinds of sugar are composed of carbon and water, or rather of carbon and the elements of water—hydrogen and oxygen—united in the same proportion as that in which they combine to form water. The authorities differ somewhat in regard to the composition, but the following table is from Muspratt, probably taken from the most recent determinations.

Name.	Composition.
Cane sugar, or sucrose	$C_{12}H_{11}O_{11}$
Fruit sugar, or fructose	$C_{12}H_{12}O_{12}$
Starch sugar, or glucose	$C_{12}H_{14}O_{14}$
Milk sugar, or lactose	$C_{12}H_{12}O_{12}$
Manna sugar, or mellitose	$C_{12}H_{14}O_{14}$

POWER REQUIRED TO DRIVE MACHINES.

One of our correspondents writes us:—"I should like to get a table giving the number of horse-power required for the different sizes of circular saws," and we have no doubt that many others who are about to start machinery would like to know what sized engines it is necessary to provide to drive their machines. For the benefit of these persons we should like to collect a large number of facts in reference to the power employed in driving different kinds of machinery, and if any manufacturer, superintendent or engineer will send us a statement of the facts in his own case, we will, if approved, publish it, thus making our paper the medium for collecting and disseminating a great mass of knowledge in regard to this important matter.

Where an engine is employed we should like the diameter and stroke of the piston, the point of cut-off, and the average pressure carried; the dimensions of the boiler would also be interesting; then a statement of the machinery driven. Where machinery is driven by water power it would be of no interest to learn anything in relation to it unless enough can be known to enable the horse-power to be computed. This would require the hight of the fall, and the quantity of water, either in pounds or cubic feet, passing through the buckets in a minute. Where this can be furnished, then a full description of the machinery in motion would be acceptable. We suggest that many manufacturers may find it to their interest to forward us a statement of these facts in relation to their establishments, while they will, at the same time, be disseminating very valuable information.

CHANGING ALCOHOL INTO VINEGAR.

By fermentation sugar is changed into alcohol, and alcohol into vinegar. An atom of grape sugar is composed of 12 atoms of carbon, 12 of hydrogen and 12 of oxygen, $C_{12}H_{12}O_{12}$, and by the vinous fermentation it is converted into 4 atoms of carbonic acid, CO_2, and two atoms of alcohol, $C_4H_6O_2$.

4 atoms of carbonic acid	$C_4 \quad O_8$
2 atoms of alcohol	$C_8\ H_{12}O_4$
1 atom of sugar	$C_{12}H_{12}O_{12}$

Then, by the acetous fermentation, alcohol absorbs oxygen from the air and is converted into acetic acid and water—1 atom of alcohol absorbing 4 of oxygen, and forming 1 atom of acetic acid and 3 of water.

$$C_4H_6O_2+O_4=C_4H_3O_3+3HO.$$

It has long been known that the vinous fermentation is caused by yeast—a low order of vegetable—the invidual being too minute to be seen by the naked eye, and it has been suspected that the acetous fermentation was caused by the action of a similar organism. The well-known French chemist, M. Pasteur, has been making some researches, which are said to settle the question. In a paper, published in the *Annales de l' Ecole Normale*, he says:—

"Acetic fermentation is always produced by the exclusive influence of an organism—the *mycoderma aceti*—one of the most simple vegetables, consisting essentially of frames of articulations slightly compressed toward the middle, measuring about $\frac{1}{5000}$th part of a millimeter in diameter, and double that in length. However much charged with albuminoid matter, no alcoholic liquid has ever been known to give the appearance of acetification without the presence of this mycoderm. On the contrary, if a trace of the mycoderm is spread on the surface of an albuminoid liquid, alcoholic or slightly acid, it is immediately seen to develop, extend like a vail over the surface, and, by a correlative action, the atmospheric oxygen in contact with the liquid disappears and the alcohol acetifies. It is not essential for the liquid to contain albuminoid matters; provided the mycoderm finds there, besides the alcohol, a small quantity of alkaline and earthy phosphates, it will live and its action be the same as before; and this identity proves that the albuminoids which have been employed were merely nourishment for the ferment, and not the ferment itself.

"If, in the actual process of vinegar making, acetification takes place without the previous spreading of the mycoderm, it must have been without the knowledge of the experimenter; it is this organism which forms the gelatinous mass which was formerly, with a vague idea of the truth, called mother of vinegar; it is this which, by spreading over large surfaces of the beechwood chips used in the German process, produces acetification. By pouring an alcoholic liquid on these chips, well washed and scoured, and thus deprived of the ferment, no trace of vinegar is obtained; but, the circumstances being favorable, acetification is produced by depositing a little of the mycoderm on the surface of the chips, where it rapidly develops.

"While alcohol is present the small vegetable produces acetic acid; but what happens if the alcohol is wanting? M. Pasteur shows that the vegetable can in this case bring its burning action to bear on the acetic acid itself, and reduce it to the state of water and carbonic acid. This effect seems to be produced only when no alcohol is present, when there is alcohol the combustion is effected by the preference on it.

"Such is the action of the mycoderm under the ordinary conditions; but it sometimes alters, and, having no longer the same appearance or the same consistence, its action is different. It is then incapable of effecting the combustion of the alcohol to the acetic stage, and gives intermediary products with a suffocating odor, and causing the eyes to water, and which have already been obtained in the oxidation of alcohol and ether by platinum black. This black, under other conditions, will give acetic acid, and here between platinum black and *mycoderma vini* there is a resemblance of effects from which