ON THE MANUFACTURE OF VINEGAR.

BY PROFESSOR L. A. BUCHNER.

Much has been said and written about the formation of acetic acid and the manufacture of vinegar, yet a few observations upon the various theories and methods may be useful. In studying the conversion of alcohol into acetic acid, there is nothing more interesting than the process, first accurately observed by Döbereiner, where alcohol is converted into acetic acid by means of finely divided platinum called platinum sponge) or platinum black, or rather its oxidation by the condensed and chemically active oxygen in its pores. In my opinion, the simple apparatus devised by that celebrated chemist for demonstrating this change illustrates the formation of acetic acid better and makes it more intelligible than the cask filled with beech shavings, which is used for the rapid formation of vinegar, where the dilute spirits trickling over the shavings are converted, by the circulation of the air and a suitable temperature, into vinegar. Döbereiner's experiment must be considered as the fundamental experiment for representing the vinegar formation, and makes the operations which take place in this process very simple. A suitable modification of Döbereiner's vinegar apparatus, which was first described and illustrated in Schweigger's "Journal," vol. 63, is constructed as follows:

Enough alcohol, diluted with 4 or 5 volumes of water is placed in a large beaker glass to cover the bottom to the depth of half or three quarters of an inch; a strip of litmus paper is suspended in the beaker, being supported by a perforated glass cover, one end projecting above the top of the beaker while the other reaches to the bottom. The platinum sponge is placed on a little dish or watch glass, and, after being slightly moistened to prevent its becoming red hot, is placed on a glass support a short distance above the surface of the alcohol. The glass cover being replaced, the apparatus is gently warmed to cause the evaporation of the spirits. As soon as this is done the litmus paper begins to redden, thus showing the acid formation. The alcoholic odor is first converted into a pleasant smell of fruit, due to Döbereiner's so called oxygen ether, a mixture of aldehyde and acetal. In a short time, however, the odor of acetic acid is recognized, and the alcohol is soon all converted into acetic acid.

In order to account for the *role* which the platinum sponge plays in this instructive experiment, we must recollect that platinum in this state has the property of condensing oxygen in its pores and thereby increasing its chemical activity to such an extent that it is able to oxydize the alcohol and convert it into acetic acid. Döbereiner found that very finely divided platinum, prepared by precipitation, absorbed, on drying, 200 to 250 times its volume of oxygen without combining with it chemically, and that it condensed it with a force equal to a pressure of 800 to 1,000 atmospheres.

Döbereiner's experiment offers a very strong proof that the conversion of alcohol into vinegar is an oxydizing process which can take place without the presence of "mother," of vinegar germs (*mycoderma aceti,*) or of any other organisms. The rapid method of making vinegar from dilute spirits, introduced by Schützenbach, in 1823, rests entirely upon the same principle. The beech shavings, owing to their power of absorbing and condensing oxygen, act in a manner similar to the platinum sponge, but less energetically. Beside these, there are many other substances which act in the same manner, such as finely divided grape vine, grape stems, bits of wood charcoal, etc., all of which condense oxygen and are used to convert spirituous liquors into vinegar. In some countries it is customary to allow cider to trickle down a rope suspended in the open air to make vinegar of it. This process, no less than the Schützenbach process, depends on the action of the oxygen condensed on the surface of the decaying organic bodies.

Pasteur's latest experiments have proved beyond doubt that, in the conversion of fermented liquors into vinegar, in the manufacture of wine, malt, or beer vinegar, the vinegar germs generated in these liquors play an essential part. But, although the mother formed exerts this power, it certainly does not do it as a physiological or vital act, but works upon the same physico-chemical ground as the platinum sponge and the decaying vegetable fiber. Many suppose, with Pasteur, that, even in the rapid vinegar process, the vinegar is formed by germs or fungi, and that here too the shavings and charcoal act only in this way: namely, that *mycoderma aceti* are generated upon them. But this opinion is entirely upset by the observations made by the late Baron Liebig in Riemerschmied's vinegar works in Munich, which are among the largest and best conducted in Germany. In this manufactory, the dilute alcohol has no foreign substance added to it during the whole operation, and is acted upon only by the atmospheric air and the surfaces of the shavings and charcoal. When a fresh quantity of dilute alcohol is to be poured in, it is only mixed with some of the partially formed vinegar of the previous operation. Upon Professor Liebig's asking Mr. Riemerschmied about the action of *mycoderma aceti* in making vinegar, the latter presented him with a sample of beech shaving from the lowest layer of a vinegar generator which had been used in this way uninterruptedly for 25 years. No *mycoderma aceti* could be found on this shaving when viewed underthe microscope, although it had become brown from the decay of the wood, but the structure was unchanged. This leaves nothing more to be wished for on the subject of the quick process in making vinegar.

In the conversion of alcohol into vinegar, we have to distinguish two stages in the action of the oxygen upon the alcohol. In the first place, the oxygen abstracts two atoms of hydrogen from a molecule of alcohol to form with it water; the aldehyde thus formed then takes up an atom of oxygen, whereby it is converted into acetic acid.

That the alcohol is not directly converted into acetic acid by the action of the oxygen, but that aldehyde is first formed, has been proved by several experiments. Döbereiner found that when 70 per cent alcohol was exposed to the action of the air and finely divided platinum, in his acetic acid apparatus above described, only long enough to begin to cause effervescence in chalk, and was then neutralized with pulverized carbonate of soda and afterwards distilled, a distillate was obtained, from which, on mixing with much powdered chloride of calcium, a large quantity of an etherial liquid separated, which he called oxygen ether. We now know, from the important works of Liebig, that this liquid consisted principally of a mixture of acetal and aldehyde; and we know, farther than that, that the former contains the constituents of ether and alcohol, and that, on heating it in contact with acetic acid, it is actually converted into acetic ether and aldehyde. In a vinegar manufactory, and also in the neighborhood of one, the same etherial smell is plainly perceptible, as is noticed at first when alcohol is oxydized by platinum sponge; and in vinegar from brandy, also, there is still some acetal or so called oxygen ether. When such vinegar is saturated with carbonate of soda, and evaporated for the preparation of acetate of soda, the whole laboratory is filled with this etherial odor.

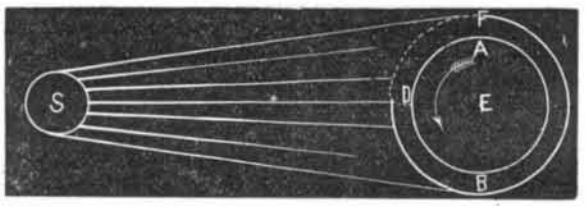
Correspondence.

Westward Movement of the Upper Atmosphere.

To the Editor of the Scientific American:

An explanation may be afforded of the prevailing east winds in the higher regions of the atmosphere, under the equator, in this wise:

Let S be the sun, E the earth, and A F the atmosphere, the earth revolving east in the direction of the arrow. The atmosphere, in passing from A to B, becomes expanded by the direct action of the sun's rays; but as this expanded air is carried rapidly eastward by the earth's rotation, the more expanded portion is always eastward of the meridian; but in passing further around, during the night and in the absence of the sun's rays, through radiation, it shrinks to its lowest limits just before sunrise, at the point, A; as it again comes under the direct rays of the sun, it begins to expand, and flows or falls back westward in the direction of the dotted line, by reason of the greater contraction and less resis-



tance in that direction, and also as affected by the earth's rotation eastward. The expanded particles, as they ascend in currents from the surface of the earth into the upper regions of the atmosphere, are constantly falling back of the meridian, the earth as it were sliding eastward under them, causing them to impinge westwardly. These winds thus move northwardly until they encounter the expanded volume of the atmosphere, as it is again brought around from the east, and continue until equilibrium becomes restored there, when they begin to fall, and curve toward the poles, where a still greater shrinkage is constantly taking place; and as they move in this direction, they are carried northeastward or eastward, when they reach the middle latitudes, by reason of their equatorial momentum.

It will be seen, therefore, that these main prevailing currents of the atmosphere are put in motion, in the mode indicated by the unequal expansion and contraction of the atmosphere, as effected by the earth's rotation.

W. L. M.

The Rights of Authors and Inventors.

To the Editor of the Scientific American:

In your issue of July 5 occurs the following sentence: "The invention by an individual of a new device, by which his fellow men are benefited, does not entitle him, by any process of natural right or natural justice, to be a monopolist over his fellows, in respect to such article." Believing that the inventor is entitled to legal protection by right, and hoping to see his claims advocated as much in the name of justice as in the name of expediency, I beg leave to disagree with you in this particular.

What is the difference between intellectual and material property? Both are the direct offsprings of labor; both are beneficial to others besides the possessor; and both have no existence save that which is allowed them by the law. Then why not accord to both the same protection under the law? No one (unless it be a rank communist) will assert that the grain which the farmer has sown upon his own land and harvested by his own labor should become the common property of the whole community. Why? Because the inner consciousness of each and every man tells him that labor bestowed upon an object gives the strongest title to possession. If this be true, the claims of the author and the inventor to the proceeds arising from their respective callings are as incontestable as those of the farmer and the mechanic. After Noah Webster had passed long and weary years in perfecting his dictionary, than which no prouder tribute to the genius of industry can be found in the English language, would justice have denied him the ownership of that great work? After McCormick has devoted his time and his talents to the invention and the introduction of his celebrated reapers, the use of which adds so much every year to the national prosperity, shall we say that he has no right to the protection which he now enjoys? When we say this, let us also assert that the farmer has no right to the grain which he has cultivated, and the mechanic no right to the cart which he has constructed.

Although intellectual property should stand upon the same foundation with material property before the law, it does not follow that we should make patents and copyrights absolute and perpetual. There are no absolute and perpetual rights of property. All rights of property are subordinate to the national welfare. The interests of our country demand that the ownership which a citizen acquires in lands and tenements shall be subject to no limitations with respect to time. But this does not follow where an individual has obtained a monopoly over a particular article. When such is the case, the dictates of the national well-being require that the monopoly shall not become perpetual.

Roxobel, N. C. JOHN E. TYLER.

The Natural Rights of Inventors.

To the Editor of the Scientific American:

You reiterate the declaration that the right, termed patent, is not a natural one, but a species of tyranny, vested in a patentee only by sufferance, or by expectancy of a justifiable return. The distinction thus made is calculated to beget or foster opposition to the claims of inventors. Club rooms long since agreed to put a limit to the bold declaration, of our Declaration of Independence, that "all men are born free and equal," a man's birth being a matter of date sometime after his exit from the womb of nature, and the circumstances of his birth being as great sometimes as the circumstance of having a birth. The fact is men are not equal by birth or by force of being, but differ in endless individualities; and law at best can only seize on a few features to found a common law for the government of men, and must necessarily leave exceptions alone. Kings and princes therefore exist and bear names to suit the places they create by their life force. The inventors are the princes of a nation, and they create kingdoms in the aggregate world of mind.

To say, then, that patents are granted by sufferance, is not saying all. The whole proposition is: "Since nature has created certain men with uncommon abilities in certain directions, whose efforts if properly directed tend to elevate and advance the common weal, it is therefore the duty of wise governments to direct, employ, and compensate such men for the common good of mankind." There is no savor of tyranny about the matter. It is simply compensation, for value received, gratefully acknowledged and so directed as to be paid. Not paid, it is true, as it should be, but prospectively provided for.

The labor of the hand is paid for, not as a tyrannical exaction, but as an equivalent for work done. Thought, the director of the million handed Briareus, is entitled to a percentage of one multiplied by a thousand, not by force of tyranny but by reason of the greater result.

Besides, the stricture, being drawn on the brain of the inventor, conveys the impression that the claim of the inventor is piratical on the claims of common men, and leads public opinion to put the brand of Cain on the brow of the benefactor of his race. This is at variance with enlightened civil practice and justice. The inventor is known to be a different kind of character. He is not predaceous but benevolent; not greedy, but indulgent. He is the first born son of Brother Jonathan, and inherits his mother's weaknesses. This son is known to be out of money often, out at elbows as he is out of the world he lives in. He goes with a lien toward the future. Old Probabilities has no station out or up so far as the cyclone curve on which he moves. It sweeps by the present into other generations. If the government can employ his time, brain and heart, the nation of a better time will respond: Amen.

THEOPHILUS WEAVER

Steam Boiler Experiments.

Preparations are being made to institute a series of practical experiments at Sandy Hook, N. Y., to ascertain the causes of boiler explosions. As heretofore recorded in the SCIENTIFIC AMERICAN, an appropriation for this purpose of one hundred thousand dollars, was made by the last Congress. The board under whose auspices the experiments are to be conducted, consists of General D. D. Smith, Inspector General of Steamboats, Captain Low, Mr. John Mushaw, Supervising Inspector, of Baltimore, and Charles W. Copeland, M. E. of this city. The experiments are expected to begin about August 1. Several boilers are to be tested and exploded, and the experiments will probably occupy three months. A series of experiments are also to be made at Pittsburgh, under the supervision of General Smith.

To Harden Plaster Casts.

I make use of either a thin milk of lime or lime water, instead of ordinary water, and add to this about ten or fifteen drops liquid silicate of soda for every pint of fluid used; then thicken with plaster to a thick cream. Plaster thus prepared will set in about five minutes, dependent on the thickness of the cream. The addition of lime evidently prevents the formation of sulph. soda, reducing it to a caustic condition, and thus allowing the plaster to stand a very hot water, besides making it very hard. If, however, too much silicate is used, the soda will effervesce on the surface, and spoil the shurpness of the impression.—*J. F. W., in Dental Cosmos.*