visible to the naked eye such an accident is easily avoided. However, if a vat be invaded the liquid is drawn off and heated by means of boiling water or steam to 60° C. The vat is washed with boiling water and a little sulphuric acid, and then filled again with the liquid that has been heated and cooled. If the vat be kept clean and the vinegar used for the mixture be heated to 60° C. the eels cannot be produced.

To preserve from eels vinegar manufactured and in stock, an inconvenience frequently due to the unsuitability of the casks, recourse may be had to heating the vinegar to 60° in large casks with limited access of air. Pasteur, in his work before mentioned, describes a practical arrangement for this process of preservation.

Among the antiseptic agents there is one of which the preservative action is remarkable, *i. e.*, salicylic acid; 0.01 per cent., or 10 grammes per hectoliter, is sufficient to preserve vinegar from eels. Unfortunately, however, in presence of the least trace of iron it gives rise to an intense blue coloration. Now, in domestic use, vinegar is frequently brought into contact with iron, and the boiling vinegar would color blue black the green parts of vegetables, such for instance as cucumbers, because of the iron contained in their chlorophyll. For this reason it is necessary to give up the use of this excellent means of preservation in the case of vinegar.

Boric acid also acts as an antiseptic, especially in the proportion of 0.04 per cent. or 40 grammes to the hectoliter. After three or four days the eels are killed in vinegar containing considerable numbers. Boric acid not being injurious to the health, if it be used in very small quantity, there is nothing opposed to its employment. Formerly, manufacturers added to vinegar a small quantity of sulphuric acid, but the sanitary authorities in this country have forbidden the practice.

A vinegar preserved by chemical agents, however, can no longer be used in the further manufacture of vinegar, for the antiseptics destroy the acetic bacteria also. The most rational mode of preservation consists, therefore, in heating the vinegar to a temperature of 60° C., as recommended by Pasteur. In the manufacture in vats the production of eels is by this means rendered impossible.

The vinegar fly (*Musca cellaris*, L.), which is found always where acid liquors are evaporating, may also cause the introduction of the vinegar eels. By walking upon the viscous disk it may get the eels attached to its feet and thus transport them to vats or sound generators. In the vats this may be avoided by making the covers fit well and covering the tubes and plugging the aeration orifices with cotton. With generators, in consequence of the continual affusions, the evaporation of the vinegar spreading over the soil renders the locality unfavorable; the vapor given off by the generators themselves also attracts the flies, the approach of which to them cannot be prevented, while the vats are completely protected.

The acetification of a new shavings generator requires six to eight weeks. According to the calculations of Paul Pfund, also, a generator absorbs 5 to 6 hectoliters of vinegar to acetify the shavings. Moreover, the vinegar produced has during the first four weeks a very distinct taste of the wood, communicated to it by the shavings. The generators ought, therefore, to be kept in action uninterruptedly.

The method of Pasteur, where the vinegar is formed by bacteria, gives, on the contrary, immediately and without loss of vinegar a salable article of good quality. Nevertheless, the vats in fermentation ought always to be under rigorous control. An insufficient addition of alcohol, or too great an excess of alcohol in the fermenting liquor, immediately slackens the fermentation or stops it entirely. But if the necessary proportions be exactly observed the practical execution presents no difficulty.

For the production of wine vinegar this method is the only rational one; for in this case it is not necessary to add alcohol, and the course of the manufacture becomes still more simple.

PROGRESS OF SUGAR ADULTERATION.

MR. GEO. T. ANGELL writes as follows to the Boston *Advertiser*:

Glucose is a cheap substitute for sugar. It is made in Germany from rags. It can be made from sawdust. It is generally made in this country by boiling corn starch in dilute sulphuric acid (oil of vitriol). It has grown in a few years from nothing to most colossal proportions. A single factory uses in making it over five million bushels of corn a year; another more than two millions. I am told that it sometimes sells in large quantities as low as two cents a pound.

Dr. T. D. Williams, of Chicago, recently analyzed over a hundred samples of confectionery there, and found more than seventy per cent. were made wholly or in part of glucose. He also recently analyzed six samples of brown sugar procured from six different sources, and found they all contained glucose. Two of them, very light colored, dry, and apparently fine articles, containing 33½ and 41½ per cent. of glucose. A Casamajor, chemist, in a paper read before the American Chemical Society, March 4, 1880, says he has found refined sugars largely adulterated with glucose.

Dr. O. W. Wight, Health Commissioner of Milwaukee, writes, November 8, 1879, that a chemist in charge of a glucose factory tells him that about twenty per cent. of glucose is put into granulated sugars; sixty to seventy per cent. into some brown sugars, and about forty per cent. into candies; that it is largely put into honeys, and constitutes the greater portion of many sirups.

Dr. Kedzie, President of the Michigan State Board of Health, some time since analyzed seventeen table sirups, and found fifteen of them made of glucose. In twenty samples of table sirups recently analyzed at Chicago only one was found unadulterated, and several of them were made almost entirely of glucose. In twenty-one samples recently analyzed by Dr. Kedzie, twenty were made wholly or very largely of glucose.

The editor of the *Chicago Grocer*, writes me that seven-eighths of all the sugars sold in Chicago are adulterated with glucose, and subsequently states in his paper that seven-eighths of all the sirups sold in that market are of the same kind. I am told by a Chicago sugar dealer that ship loads of it are sent to New Orleans to come back as New Orleans sugar and molasses. It is largely used not only by confectioners, but also by bakers, brewers, in jellies, jams, preserves, honey, maple sugar, beers, wines, liquors, and is constantly being put into new uses, and I am informed that it is sold in immense quantities to sugar refiners.

Recently a Glasgow, Scotland, grocer was fined for selling American honey which contained fifty-seven per cent. of glucose. What is the character of this article? Not as it may possibly be made in a chemist's laboratory at high cost,

but as it is made and sold for two or three cents a pound in our markets. The *Chicago Grocer*, of September 25, 1879, says: "The manufacturers deny admittance to their factories." The *Chicago Tribune* says: "The manufacture is carried on with as much secrecy as the illicit distillation of spirits."

Professor Charles R. Fletcher, Chemical Lecturer to Boston University and State Assayer of Massachusetts, writes that he has recently analyzed three samples of best solid glucose and two samples of the sirup, grades A and B, and in every sample found free sulphuric acid (oil of vitriol). In one sample of best glucose he found thirty grains of oil of vitriol to the pound of glucose. In a sample of the best sirup he found nearly as much.

Dr. Kedzie (before quoted) found in one sample of glucose sirup 141 grains of oil of vitriol and 724 grains of lime to the gallon; and in another, which had caused serious sickness in a whole family, 72 grains of oil of vitriol, 28 grains of copperas, and 363 grains of lime to the gallon. Dr. T. D. Williams, of Chicago, states that in the various samples of glucose sugars and sirups he has found in every sample quantities of free sulphuric acid (oil of vitriol).

Dr. Williams also states, in a letter of April 9, 1880, that he has found glucose products almost invariably contaminated with lead, and that Professor Mariner, of Chicago, tells him that he has recently found lead in almost every sample he has analyzed. Professor Mariner testified last October that he had examined several glucose sirups, and found in them chlorides of tin, calcium, iron and magnesia, in quantities which made them very poisonous.

Dr. Wight, of Milwaukee, Commissioner of Public Health, writes, November 8, 1879, that an eminent chemist and college professor tells him that he has analyzed many specimens of sugar for muriate of tin, and has frequently found it in dangerous quantities. Professor Mariner, before quoted, testified last fall that out of fourteen samples of sugar analyzed by him, he had found in twelve of them tin in the form of a chloride, an active poison. The students in the School of Mines of Columbia College, New York city, extracted some time since quantities of tin from sugars, and hung the lumps to the necks of the bottles from which they were taken.

President Kedzie, at a meeting of the Michigan Board of Health, January 14, 1879, said that as a general thing cheap sugars in Michigan were adulterated, that poisonous materials were used to color sugars, and that A coffee sugars often and B and C coffee sugars almost always contained lead salts. The *Journal of Materia Medica* says "the use of tin in glucose sirups has been proved by numerous analyses."

In the valuable recently published book styled "Food Adulteration," I find a case in which the men employed in twelve different Michigan lumber camps were poisoned by eating glucose sirup. Mr. Stearns, the great manufacturing chemist of Detroit, told me last September that he could not buy a pound of sugar in Detroit which he could use to coat his pills. Dr. Kedzie says that hams cured with glucose have been found to mould, blacken by heat, and become bitter.

J. M. Chapman, a most respectable Chicago sugar dealer, testified in that city, last October, that, in his opinion, not more than one barrel of sugar in a hundred now sold in that city, is pure, the rest being what are called "doctored goods." Another large Chicago sugar dealer, J. H. Dunham, at the same time gave evidence to confirm this statement. In the interests of Boston sugar merchants and grocers, and the far greater interests of public health throughout the great West, I think the contrast between Massachusetts sugars, as shown by Mrs. Richards, and Western sugars as shown by all these authorities, should be widely known; and I earnestly hope our State Board of "Health, Lunacy, and Charity" will push the investigation into all other articles of common household use.

The German Government caused 231,478 analyses of different articles to be made in the year 1878, and obtained 3,352 convictions in the courts. I know of no reason why similar precautions are not needed as much in this country as in Germany.

THE CHEMICAL REACTIONS OF MORPHINE.

DR. E. HOLDERMANN has published in the *Chemiker Zeitung* a short article on the chemical reaction of morphine, which reveals some new facts, and of which the following is a translation: By a well known reaction of morphine a yellow color is given to a solution of iodic acid in which morphine is present, and this yellow color is produced by the secretion of free iodine. When I first made a more exact investigation of this reaction, trying to find out if by means of the reduced iodine, the quantity of which was ascertained by iodometric analysis, a quantitative relation could be established between this iodine and the quantity of morphine by which it had been reduced, and when I further tried to discover what kind of a chemical compound the morphine had been reduced to during this reaction, I obtained some interesting results which I will describe in the following lines:

The chemical solutions used for my experiment were: 1. A solution of hydrochloride of morphine of known strength. 2. A solution of iodic acid, also of known strength. 3. Those solutions which are necessary for iodometric analysis, *viz.*, sulphurous acid of 0.03 strength, and a solution of iodine of known quantity.

First, I tried to ascertain the real amount of iodic acid by adding an excess of SO₂, and by treating this liquid with a solution of iodine, believing that the following process would take place:

This process really takes place, but scarcely has one come to believe that a final result has been reached, when, after again adding an excess of SO₂, the blue color reappears (in presence of starch solution). This phenomenon is repeated after each adding of SO₂, be the quantity whatever, but the pauses after which the blue color (or if no starch is present the yellow color) reappears, increase. The reason of this play of reaction I attributed to the action of the light; and I found that I was right, for at an almost complete exclusion of daylight the pause before the reappearance of the color was nearly three times as long as when the experiment was made in the clear light of day. The increase in the pauses seemed to be dependent upon the increase of the dilution.

Making this assumption, I had, of course, no right to consider the reduction of iodic acid by means of morphine as the measure of the chemical process which takes place during this reduction, therefore I tried to discover if the reductive influence of the morphine could not be combined with another process of reduction, and I therefore chose the pro-

cess which takes place during the distillation of bichromate of potassium with muriatic acid. It is well known that bichromate of potassium is reduced according to the following equation:

If this chlorine is led into a solution of iodide of potash an equivalent volume of iodine is set free. The quantity of iodine is determined by an addition of SO₂. If first a certain quantity of bichromate of potash has been examined as to its composition, and then a weighed quantity of it has been distilled together with a weighed quantity of hydrochloride of morphine after an addition of HCl, a certain relation between the quantities of chloride developed will be discovered. The quantity of chlorine will have been diminished in the same proportion in which the quantity of pure morphine contained in the hydrochloride of morphine differs. In my future experiments I will try to ascertain whether this fact will be of any value for the quantitative determination of the morphine. The late experiments have been made principally to find out the reductive value of the morphine, and to draw from this value the conclusion, what chemical compound has been found by the oxidation of the morphine.

After having made a series of experiments, I have divided the quantity of iodine which disappeared by the atomic weight of the iodine, and the quantity of morphine contained in the used hydrochloride of morphine by the atomic weight of the morphine. In bringing the thus obtained quotients to their simplest relation by dividing both quotients by the smaller one, I have discovered that one equivalent of morphine nearly corresponds to nineteen equivalents of iodine, which seems to me very remarkable, for one molecule of morphine contains exactly nineteen atoms of hydrogen. The nineteen equivalents of iodine correspond to I₂O, which are used for the oxidation of the morphine molecules. It is possible that every two molecules of morphine unite with nineteen more atoms of oxygen, or that nineteen atoms O deprive two molecules of morphine of all their H while forming water.

PURIFICATION OF SEWAGE.

THE city of Paris, says the *British Medical Journal*, has practically tested various chemical and other means of dealing with its sewage, and is now irrigating about a thousand acres of land within five miles of the Tuileries. It is, therefore, interesting to find that on June 23rd last the Municipal Council of Paris resolved, among other things, "To approve, first, the continuation of irrigation in the fields of Gennevilliers, and the carrying of the sewage to the lower north-western part of the peninsula of St. Germain and adjoining farms, and the delivery of sewage from the conduits to persons on their routes who shall be willing, by agricultural, chemical, or other means, to cleanse it at their own expense and risk for the sake of what they may be able to get out of it, subject to rules to be prepared; secondly, to ask the Government, in case the 1,500 hectares (3,700 acres) should be insufficient for the purification of the sewage without annoyance to the neighborhood, to take into immediate consideration the extension of the present proposal and the irrigation of other districts in the valley of the Seine."

DONATO TOMMASI'S DEFINITION OF NASCENT HYDROGEN.

DR. DONATO TOMMASI, the renowned Florentine chemist, was a short time ago accused of plagiarism, and has, therefore, written a letter in which he shows the invalidity of this accusation. He writes as follows:

I have just received from the secretary of the Holland Society of Sciences in Harlem the original memoir of Dr. Phipson about catalytic force. In the first place, I have most sincerely to thank Mr. Von Baumbauer for sending me, voluntarily, the work of Dr. Phipson. I have read this memoir with much interest; and though I do not share the ideas of my honorable adversary, I cannot help congratulating Dr. Phipson for the clear and learned manner in which he has treated so difficult a question as the catalytic force. Dr. Phipson, in his memoir, limits himself to the catalytic force, and to that alone; the question of the nascent state of bodies he scarcely touches. His pamphlet on the catalytic force consists of thirty-four pages, and Dr. Phipson dedicates not more than half a page to the nascent state of bodies. The following are the contents of this half page:

"It has been known, ever since chemistry existed as a science, how much the nascent state of a body influences the combinations which it is able to form; some combinations are only possible when one of the bodies is in a nascent state, while, for the formation of others, both bodies must be in this condition. That which is called the nascent state is, in my opinion, nothing else than the allotropic state of bodies that are about to form a compound. Some time ago I published this view of the case. Mr. Houzeau seems to be of the same opinion. It is almost unquestionable that whenever oxygen enters into combination, or when set free from a compound, it is in the state of ozone. Considering the results obtained with hydrogen, chlorine, bromine, sulphur, phosphorus, etc., we may well conclude that the same is true of all simple bodies, *viz.*, that all those bodies can be in an allotropic state analogous to that of ozone; that they are in this condition at the instant when they enter into combinations—that is, they are then in a nascent state."

My own view about nascent hydrogen was expressed in the following manner:

"If hydrogen in a nascent state is endowed with a greater affinity than in an ordinary condition, this proves that, when set free from a combination, it contains the entire quantity of heat which was produced by its being set free. Consequently, nascent hydrogen is nothing else but ordinary hydrogen under different physical conditions. I regard nascent hydrogen as identical with hydrogen + calories. In fact, all the reductions produced with nascent hydrogen can be obtained with ordinary hydrogen at a very high temperature, and the differences observed between the hydrogen which is set free by chemical reactions show only that the quantity of heat which is set free by these reactions is not always equal."

Now I ask, What resemblance can be detected between the definition which Dr. Phipson has given and the one I have given?

How could Dr. Phipson say that my theory of the nascent state is the same as that advanced by him in 1858, with the only difference that I have put the word "caloric" in the place of "electricity," although Dr. Phipson, in his memoir, does not once mention the word electricity? What experiments has Dr. Phipson made to prove that nascent hydrogen consists only of hydrogen accompanied by