and Toxicology, of Yale Medical College, Prof. Austin Flint, Jr., Prof. Charles A. Seeley, and Mr. Place, all testified in the most positive manner, that by following an old formula of the celebrated chemist, Berzelius, given in Gmelin, they had produced an acid phosphate in the form of a fine, white, dry, non-hygroscopic, homogeneous powder, capable of evolving carbonic acid and producing phosphate of soda in its reaction with bicarbonate of soda, and otherwise presenting all the properties of the article described in the plaintiff's patent. These witnesses had repeatedly tried the formula and they exhibited specimens of the powders thus produced. One of the witnesses, Prof. Seeley, testified that when the formula of Berzelius was intelligently followed it was impossible to produce any other substance.

On the other hand, the distinguished Prof. R. Ogden Doremus, of the Medical Societies in this city, testified for the plaintiff, that the formula of Berzelius does not contain such a description as will enable him, as a practical chemist, to produce such a substance as the previous witnesses had described. He had, he said, made but one trial, which resulted in a white powder having an acid taste which soon became inert, and would not, when mixed with bicarbonate of soda, set free carbonic acid.

Professor Horsford testified that he had devoted much time to the subject, but had been unable from the formula of Berzelius to produce the article described by the witnesses for the defense. The substance which he had produced was sometimes sticky, and from day to day lost its strength, until it had no capacity to decompose bicarbonate of soda.

Here was a marked disagreement in the testimony of the learned doctors; but it does not seem to have troubled Judge Blatchford very much. He decided the matter readily, and at the same time gave the learned professors a very useful lesson in practical chemistry, by advising them to make their acid solutions a little stronger, when they would probably be able to produce the substance described by the *savans* of Yale.

Although this trial has resulted adversely, in part, to the very broad claims set up by the Rumford Chemical Works, it will not in any manner interfere with the continued manufacture of their excellent phosphoric acid preparations, which are made under the personal supervision of Prof. Horsford. If in point of law he is not the original discoverer of the acid phosphate powders, he is undoubtedly the first to develop a method of making them commercially available, and thus to put the public in possession of a valuable article, the use of which is of great importance as a constituent of food. The celebrated Liebig has stated that the nutritive value of ordinary flour is increased ten per cent by the use of Professor Horsford's phosphatic bread preparations.

THE THEORY OF BOILING---TOMLINSON'S EXPERIMENTS AND CONCLUSIONS.

There have been few who have contributed more to the general stock of knowledge during the past year than Charles Tomlinson, F. R. S., F. C. S. Especially valuable is his theory of boiling as applied to the useful arts, of which we can give only a brief and cursory review. We will, however, endeavor to give our readers some of the most prominent points and practical conclusions.

According to this theory, a boiling liquid is a supersaturated solution of its own vapor. This is proved by holding a nucleus *in any part* of the liquid. It will instantly become covered with steam bubbles.

But what is a nucleus? It is a promoter of vaporization, which acts by virtue of its stronger adhesion for the vapor of the solution than the liquid from which it is produced. Among the most common and well-known nuclei are the soap used by distillers, butter used by the sugar refiners, bits of cedar used in Dr. Bostock's experiments, the brass wire used by Oersted, the pointed or rough bits of platinum used in chemical experiments and operations, etc.

Mr. Tomlinson has shown that all these nuclei are imperfect, that if they act well at first, they are likely to become inert during a single operation, and, therefore, unreliable, and, as the result of his researches, he has discovered nuclei which will not only greatly facilitate the escape of vapor from boiling solutions, but which, acting upon an entirely different principle from the ones enumerated, and others similar to them, may be relied upon as permanent and uniform in their action: these will be named further on.

Mr. Tomlinson says "all the substances which have hitherto been used empirically, because the principle which led to their adoption was not known, must be renewed at each operation, and as they are liable to cease their action before any operation is completed, they are liable to objection." They will cease to act as nuclei whenever they become chemically clean.

In Mr. Tomlinson's paper upon this subject, read before the Society of Arts, he remarks: "It has been recommended to use sharp-pointed or roughened bodies, under the impression that steam is given off with greater facility from the points or the teeth. This is a mistake. Make these rough or sharp-pointed bodies clean, and they cease to act. Sharp, angular fragments of glass, washed in sulphuric acid and rinsed, no longer act as nuclei. A rat's-tail file passed through the flame of a spirit-lamp also becomes denucleized. A body such as a file is apt to collect between its teeth the greasy kind of matter that acts so well as a nucleus; and this has led to an idea in favor of rough bodies. The air is not a nucleus. When Dr. Bostock found his thermometer cease to act, and by taking it out of the liquid and waving it in the air it liberated vapor when restored to the liquid, the thermometer had caught from the air some unclean particles of dust, which acted for a moment as nuclei, until, by the action of the ether, they became denucleized."

Mr. Tomlinson states that he has performed a very large number of experiments on the action of nuclei on various liquids at or near the boiling point, and they all point to the same conclusion; namely, that the action of a nucleus is differential, there being a greater amount of adhesion between the nucleus and the thing dissolved than between the nucleus and the liquid. In the great variety of cases the nucleus is contaminated with some kind of oily, fatty, or greasy matter, and this, having a less adhesion for the liquid part of a solution than for the gas, or the salt, or the vapor of such solution, there is, consequently, a separation of gas, or salt, or vapor. The nucleus may be a solid thrown into t e vessel, or the sides of the vessel may act as a nucleus, or f tty matter may be thrown in, in order to make the vessel unclean, as in the case of the distillers and the sugar boilers. But in all cases of solid or liquid nuclei, we may always observe this differential kind of action, on which, he contends, the action of nuclei depends. The following experiment illustrates this:

Five ounces of distilled water in a clean flask boiled at $213\frac{1}{2}\frac{7}{0}$° Fah. Some perfectly clean mercury was poured in, enough to form a ring at the bottom of the flask. The water rose to 214°, with much bumping, steam forming under the mercury, and distending it into hemispheres, each of which burst with a kick. It would have been dangerous to have entirely covered the bottom of the vessel with the metal, for, as it was, the bursts were of an explosive character. While this uneasy boiling was going on, a very little dirty mercury was added to the flask, and, although the mercury was not more than one sixth of that previously added, the effect was remarkable. Instead of the uneasy kicking, jerking bursts, the boiling became brisk, easy, and soft, rapid volleys of steam-balls being given off by the metal, breaking up the mass of water, while the temperature remained steady at $212\frac{2}{20}$°.

Further experiments will be alluded to in a future article, showing the reasons for selecting charcoal, coke, pumice-stone, and especially cocoa-nut shell charcoal as the best known nuclei. Our readers engaged in dyeing, distilling, etc., will not fail to see the importance of this subject, as well as its possible application to saving of fuel in steam boilers, since whatever tends to lessen the adhesion of steam to the water contained in boilers, helps to economize fuel. The experiments we shall give in our next bear strikingly upon this point.

THE ODORIFEROUS PRINCIPLES OF PLANTS---AND THEIR IMITATIONS---FUSEL OIL.

No doubt many of our readers have, while enjoying the delicate odor of a rose or a cape jasmine, wondered what it is that these and other plants possess which imparts such delicious perfumes. Chemistry has answered this question definitely, and has shown that these odors arise from volatile oils existing in the tissues of plants. Sometimes it is the flowers, sometimes it is the bark or wood that contains these essential oils. Some may be obtained by distillation of the flowers, leaves, bark, or wood, with water; others are so evanescent and destructible that more refined processes have proved necessary, and some elude all attempts to secure them.

The elements which compose these oils are only three, oxygen, hydrogen, and carbon. Charcoal and water, therefore, contain all that is necessary to their composition. Many of them are hydrocarbons mixed with an oxidized oil, and in others the oxygen enters as a chemical component. Of these last attar of roses is an example.

These oils have taste as well as smell, and give peculiar flavors to fruits, wines, and liquors distilled from fermented fruit juices. These flavors are called the bouquets of liquors. The composition of brandies, wines, and other liquors, being little else than alcohol, water, sugar, with coloring matter and a peculiar bouquet, the idea of making factitious imitations was a very natural one. In applying it to practice it was found that the chief difficulty lay in the imitation of the bouquet. Many of these have been since successfully imitated, and the substances produced form a class scarcely second in interest to any in organic chemistry.

The readers of the daily papers and the scientific press have seen so much said of fusel oil during the past year, that the name has become very familiar. They have, therefore, learned that this is a substance generated during the distillation of whiskey from potatoes, and also by other methods to which we need not refer. It is analogous to the alcohols in its reactions, and having for its base a peculiar radical called amyle, it has received the name of amylic alcohol. It has a very nasty smell, and most of its compounds and derivatives are characterized by their peculiar odors, which imitate to a nicety the odors of various plants, fruits, etc., as well as those of insects. From perfumes the most agreeable it is but a step to the utterly nasty and disgusting. A few examples will illustrate.

Drop amylic alcohol on platinum black. It immediately oxidizes to an acid which gives the smell of *valerian*.

Distil amylic alcohol with acetic acid obtained by the decomposition of acetate of potash with sulphuric acid in the retort, and an oily product smelling exactly like the *Jargonelle pear* is generated.

Distilling with chromic acid obtained in an analogous manner to the above, and an oil smelling like *apples* is produced.

Cognac and *grape oils* are imitated by the action of concentrated sulphuric acid upon the same radical.

Products having the odors of *bananas*, *oranges*, and many other kinds of fruits, are successfully imitated by analogous methods. In fact some chemists have affirmed that these oils are identical with those naturally compounded in the growth of plants.

But the odors thus produced, as we have already said, are not by any means all of them pleasant. The odors of disgusting plants, bed bugs, squash bugs, etc., etc., are equally attainable though not in general request.

Another class of substances possessing odors similar to those found in certain species of plants are the sulphur alcohols, as they used to be called, or the sulphides of ethyl, one of which corresponds to alcohol with its oxygen replaced with sulphur. This last is also called mercaptans on account of its affinity for mercury, (*mercurium captans*). The method by which it is produced from alcohol is indirect, and would scarcely be intelligible to the general reader. The composition of this alcohol is $C_4 H_6 S_2$, that of wine alcohol being $C_4 H_6 O_2$.

The odors of these sulphides of ethyl are like those of garlic, onions, leeks, etc. A similar compound prepared from methylic alcohol is a clear liquid, without color, but having an intolerably offensive odor of onions, which is very tenacious.

The sulphur in these compounds may be replaced by arsenic, giving rise to new compounds indescribably disgusting, and as noxious as they are offensive. Kakodyl is the name of one of these compounds, a name of ill portent, from the Greek *kakos* evil, *hyle* principle. It unites with cyanogen to make a frightfully poisonous volatile compound, a few drops of which evaporated in a room will produce almost instantaneous unconsciousness upon any unfortunate who chances to be present.

We may not extend this article further. Suffice it to say that we have mentioned only a few of the odors that may be successfully imitated by chemical compounds.

PREDICTION OF WEATHER.

The prediction of the weather from natural indications has been attempted from time immemorial; but hitherto the weather prophets have been compelled to confess that "all signs fail in dry weather." Professor Houzeau, formerly of the Royal Observatory at Brussels, has been making observations for years, and has finally published a general table whereby he claims the weather may be predicted for a short time in advance with considerable certainty.

The things to be observed are, the direction of the wind, the state of the barometer, and the state of the sky. These three states may be expressed thus: Barometer rising, falling, fixed, or very slow, falling fast, rising fast, rising slowly after sinking very low, sinking very low and for a long time.

The sky is described as being blue, cloudy, rainy, or snowy, fine, cloudy with rain or snow at commencement of wind, fine with light clouds, veiled, hot after rain, covered, fine rain falling, hot after westerly rain, etc., etc.

The directions of the wind are expressed in the points of the compass as usual.

In the absence of all definitions we must say we think these terms exceedingly indefinite. To us, the differences between a fine sky and a blue sky, or a veiled sky and a covered sky are not quite apparent. The looseness of this terminology is scarcely indicative of scientific accuracy, although the antecedents of Professor Houzeau would lead us to expect it.

We cannot give the table of indications prepared by Prof. Houzeau, but will give only some examples.

A rising barometer, with blue sky and wind N., indicates cold and dry weather. Same, with cloudy sky, weather will clear up. Same, with rain or snow, wind will change to N.E., with alternate showers and sunshine.

Barometer fixed, or very slow, with fine sky, wind N.E., the wind will continue, and weather become dry. Same, with cloudy sky, rain, or snow at commencement of wind, the same result may be expected as before.

These examples will serve to show the method employed. It must be remembered, however, that if the predictions thus made should prove very accurate for the locality of Brussels, they would not be likely to be so in other places remote from that point, though it is fair to infer that if the states of the barometer, sky, and the wind are sufficient data in one place, they would, also, be enough in another. The interpretations would, therefore, be subject to amendment.

For ourselves, we confess our faith is small, but as there is nothing apparently impossible nowadays, there may be something in Professor Houzeau's table.

Compressed Fuel from Coal Dust.

In Great Britain the quantity of coal dust remaining unemployed is calculated at 28,000,000 of tuns. Various methods have been attempted to convert it into useful fuel by compressing it into cakes, but the operation is not sufficiently remunerative. In Belgium they follow another plan, which seems to answer better. They mix coal dust with 8 per cent of tar, and then press it into cakes, which are found to make excellent fuel for steam engines. The dross accumulated in iron works, to the amount of millions of tuns, is known to contain from 25 to 50 per cent of iron, but the difficulty of extracting is very great, the metal being intimately combined with various silicates, and other substances, which are not easily separated by fusion. Lime, indeed, will decompose these silicates, but the iron thus obtained is brittle. Nevertheless, M. Fleury has recently made a successful attempt to obviate this drawback by slacking the lime used for the purpose in water containing a certain proportion of some alkaline chloride.

The Architectural Review contains a description of a patented frost-proof tin pipe for gutters. Instead of being cylindrical like ordinary pipe, it is corrugated longitudinally, so that when water in it expands by freezing, the pipe also expands approximating the cylindrical form. The idea of making corrugated pipes for the above purpose is quite old, and has been the subject of applications for patents.