which unequally refract the rays of light and produce many shades of color of marvelous delicacy. This effect may be artificially produced upon glass and other substances, by cutting lines thereon of sufficient fineness. Mr. Rutherford, the well known scientist of this city was, we believe, one of the first to construct a machine capable of engraving these iridescent lines. These he produced upon glass, as test objects for microscopes. The cutter was worked by an electro-magnetic machine. Another of these instruments is now to be seen at Harvard University, and is thus described in the Boston *Globe*:

Among the many curious inventions existing beneath the dome of the Cambridge observatory, there is a machine which is used to delineate upon glass the figure of a circle or square, by means of finely drawn lines. This machine, which is the invention of Mr. Rogers, who is connected with the observatory, is very simple in its operation, and draws each line with an accuracy which is very surprising. This is done by means of a graduated plate of metal, which acts upon a very sharply and very finely pointed needle, so that it may be set at any distance from a line already drawn. By actual trial, the skillful inventor drew upon a small piece of glass twenty-four lines, separated by a distance of a 2400th of an inch, in about a minute's time. These wonderful lines could be easily counted through a microscope, but viewed with the naked eye they formed a single, but somewhat imperceptible, line. It was nearly impossible to imagine the exceedingly minute distance which separated them. Parallel lines had been drawn upon other plates of glass, which, though apparently single, were found, when placed beneath the microscope, each to be composed of several distinct lines A circle, also, which was about a quarter of an inch in diameter, contained sixteen hundred lines. The light was very beautifully reflected from their minute sides, and the circle glistened and sparkled with all the colors of the rainbow. Upon one plate of glass had been traced circles within circles, the lines of which they were composed being scarcely discernible; but when perceived through the microscope each line assumed a perfect precision, and the delicate symmetry of each circle came out in exquisite relief. The extremely minute space in which this immense number of circular lines was contained appeared to be very wonderful. There were many other drawings, which were equally astonishing, and which showed equally well the fine skill of Mr. Rogers. It was curious to find among the great instruments of the observatory, which sweep every portion of the heavens and travel along the great equatorial circle, this little machine, capable of producing lines which hid themselves in their minuteness from the unaided eye of the observer.

THE LAKE SUPERIOR COPPER REGIONS.

It will be perceived from the letter of our esteemed correspondent, Professor Thurston, which we elsewhere publish, that he has reached the heart of the wonderful mining regions of Lake Superior, where he is busily engaged in the examination of the most important localities. He gives us the details of the methods now practiced there in mining copper, which will be read with much interest.

REMARKABLE THUNDERSTORMS.

Portions of New York State and the New England States were visited on August 14, 15, and 16 by some of the most terrific thunderstorms ever experienced. In a newspaper account of the results of one of these storms at Boston, Mass., and vicinity, the names of twenty-seven persons are given who were more or less injured by the lightning, while at least one hundred more individual cases are referred to whose names were not ascertained. Over fifty buildings are also particularly designated as having been struck and damaged, while many others are referred to as having been struck but not injured. In various other parts of the States mentioned, extensive damages were occasioned and some lives lost. The poet Whittier, at Amesbury, Mass., was struck, but not seriously hurt. His dwelling was somewhat broken. The aggregates reported, as near as we can estimate, indicate that some two hundred buildings were struck and damaged, over one hundred and fifty persons were struck, and some ten individuals were instantly killed. Quite a number of barns, with their contents, hay and cattle, were fired and consumed.

An intelligent observer at Arlington, Mass., writes to the *Boston Transcript*, describing a midnight thunderstorm at that place, August 14:

"Brilliant streams of the electric fluid darted athwart the sky in every direction, and the thunder which followed was constant for a period of thirteen minutes, without the intermission of an instant of silence. One flash of lightning followed another in such rapid succession as to excite curiosity to know how many occurred in a minute. With watch in hand, I counted them for seven minutes:

1st	minute	there were	51	vivid flashes,
2d	"	"	42	"
3d	"	"	30	"
4th	"	"	47	"
5th	"	"	37	"
6th	"	"	61	"
7th	"	"	54	"

making three hundred and thirty-one discharges of electricity in seven minutes, distinctly visible from one point; and each discharge was followed by loud and sometimes rattling reports, whose reverberations rolled through the heavens in an endless procession of majestic and terrific sounds.

"During this scene the moon, which was about half an hour above the western horizon, was visible, but so magnified through the haze and vapor as to appear like a brilliant flame suspended in the sky. For a period of twenty minutes, the scene was one of grandeur and sublimity rarely witnessed in a lifetime."

Nearly all of the church spires and dwellings that were provided with rods escaped injury, though heavy charges of electricity were observed to pass down the rods. Cars while running on some of the railroads were surrounded by the electric fluid, but no passengers were injured, although many were greatly alarmed. Telegraph wires were melted by the half mile, poles shattered in all directions, telegraph instruments in some cases broken, while the fingers of a number of telegraph operators were singed and temporarily paralyzed.

At Poughkeepsie, N. Y., during the storm on August 14, the following phenomena were observed, as reported in the New York *Herald:* "The lightning flashed from horizon to horizon incessantly in forked tongues and jagged chains, and it really seemed as if every flash struck something, because they were instantaneously followed by rattling and stunning thunderclaps. Looking up Main street from the Post Office, balls of fire were seen shooting into the Atlantic and Pacific Telegraph office, and explosion after explosion followed, like the rattle of musketry, as the electric fluid struck the telegraph instruments, creating terror in the hearts of everybody in the vicinity. At the Western Union Telegraph office, a ball of fire entered the window and exploded on the desk of the operator, and was followed by other electric explosions driving the operators away from their business.

"At the depot the effect was also startling. In the telegraph office, the Superintendent, J. M. Toucey, of the Hudson River Railroad, and Robert Wilkinson, the night operator, were seated at the instruments, and the operator was working the wires during the storm, because of the washing away of a culvert near Catskill making telegraphing necessary. While they were busily engaged, there came a blinding flash of lightning, and at the same instant a ball of fire dropped from the Poughkeepsie and Eastern Railroad wire and exploded on the desk between Mr. Toucey and Mr. Wilkinson. Both were affected, Mr. Wilkinson's ears and fingers tingling with electricity. Further work ceased at once till the storm subsided. The engineer of the down train witnessed fearful scenes along the railroad while his train was in motion. Streaks of lightning ran around his engine and over it, and down upon the railroad track, shooting far ahead of the advancing train, and the air seemed to be impregnated with sulphur.

"The steamer Mary Powell landed her passengers here while the storm was in progress. Captain Anderson took hold of the bell wire to ring the engineer's bell, and received a shock that came near knocking him down.

"Strange to say not a building in this city was struck. The lightning was of various colors—pale green, violet, and crimson. The people generally were much alarmed."

MANUFACTURE OF VINEGAR.

There is perhaps no process in the arts which proves more clearly the value of theoretical knowledge, when properly applied, than the manufacture of acetic acid or vinegar from wine, cider, spirits, malt, etc. Even the details of this process show how the apparently useless discoveries of the theoretical chemist may be made available to the manufacturer. So it was often a subject of wonder how some vinegar establishments, apparently conducted in a proper manner, could never obtain the quantity of acetic acid obtained by others, and requisite according to correct theory. This became all clear when Liebig discovered aldehyde, referred it to a low oxidation of alcohol, which by a large supply of oxygen would have become acetic acid. With his characteristic practical common sense, he applied this at once to the vinegar manufacture, and showed that the losses observed were solely due to the formation of aldehyde, from an insufficient supply of air, and that when admitting more air, by increasing the openings or by any other means, this difficulty would be entirely obviated.

We have received an interesting letter from one of our subscribers, a vinegar manufacturer in this State, extracts from which we publish in another column, which illustrates another point of a similar kind in the same business. He complains that his large stock of good cider vinegar on hand became weaker and weaker in the vats, and at last so tasteless that he had to run it in the canal. The loss was nearly his ruination, as there were several thousand gallons; it appeared to be contagious, as one vat after the other became thus contaminated. He gives us an elaborate account of the locality, the circumstances, manipulation, temperature, etc., so as to put us in a condition to judge about the causes and suggest preventives of its re-occurrence, and, thanks to the pains taken in this respect, we think we are able to point them out.

The whole cause of the trouble experienced, which is well known to practical chemists, is the so called mother of vinegar, a mold which, investigated by naturalists, has proved to be a vegetable parasite of great vitality, and is called *micoderma aceti* or *ulvina aceti*. It grows at the expense of the acid in the vinegar, and destroys it at last totally. It forms also on the beech shavings of the vats, but is then beneficial, as it assists in the change of the alcoholic into the acetic principle; but if once this change is totally accomplished, it is an enemy of the manufacturer, as its continued growth is at the expense of the acetic acid. Mulder, in Utrecht, Holland, investigated this subject minutely, and found that, when he removed the fine floating skin of this vegetable parasite with the utmost care, it always reappeared again, while the vinegar became weaker and weaker.

It is, of course, difficult to prevent the passage of the germs of this plant from the vat with the shavings into the storage vats. Heat will kill it, and therefore we would recommend the method followed in France for the improvement of some kinds of wines, namely, the passage of the liquid through a coil heated to 212° Fah., which destroys all vegetable life, and which we may describe more in detail in the future. It must also be observed that there is more danger of this deterioration taking place in weak vinegars than in strong ones, and that the presence of a little alcohol will prevent it for a time, as then the action of the vegetable parasite will be first expended to change this alcohol into acetic acid, and will not attack the latter before the former is all consumed. There is still another point: It is well to clean the vats with hot water, but it is advised by many writers on this subject to wash them afterwards with quite strong vinegar, so as to saturate the pores of the wood with this in place of with water, before introducing the vinegar. Still another point: As cider vinegar contains many other vegetable ingredients besides acetic acid, it is advisable to filter it when the fermentation has ceased. A deposit, near the bottom of the storage vats, of these vegetable matters is very apt to cause a putrefactive fermentation, which will also injure and at last destroy the acetic acid formed.

SCIENTIFIC AND PRACTICAL INFORMATION.

ORNAMENTAL WOODWORK.

C. Muratori, of London, makes wood ornaments by kneading alum, glue, and sawdust, with boiling water, into a dough which is pressed into molds. When dry, it is hard and capable of taking a high polish Similar ornaments, of greater beauty and resembling carved woodwork very closely, are being made in this city by pressing veneers between steel or copper dyes.

GLYCERIN AND THE COAL TAR COLORS.

It may not be generally known to all our readers that the aniline colors are quite as soluble in glycerin as they are in water or alcohol. It has recently been suggested to use the glycerin bath for dyeing, and F. Springmühl has instituted a series of experiments with woolens, silks, and cottons, and has obtained very good results with all the coal tar colors. Whether glycerin will not prove too expensive is as yet doubtful. Some of the glycerin is of course lost when the goods are rinsed after being dyed, if no mordant is used, and it is seldom required when glycerin is employed. The glycerin of the bath itself can be used indefinitely by adding a fresh quantity of the dye stuff, which very readily dissolves in it.

Comparative experiments were made with wool and silk dyed in equal quantities of the same dyes dissolved in glycerin and in water, the temperature of the baths being the same. It was found that those dyed in the glycerin bath always had a livelier color, and the silks especially were more glossy than those dyed in aqueous solutions. If the temperature of the glycerin bath is raised above the boiling point of water, the colors are still better and faster.

If glycerin is too expensive, it could at least replace alcohol as the solvent. The addition of glycerin to a water bath raises its boiling point, which is of great use with iodine green, and makes it attach itself more readily to the fiber; this is strikingly noticeable in the case of cottons. The action of mordants is in no wise injured, but rather improved, by the dye bath containing glycerin. When alcohol is used as solvent for the dye stuff, a portion of it is lost by evaporation, while all the glycerin remains in the bath, even at the temperature of boiling water, and hence none of the dye stuff is precipitated.

PARIS GREEN AND POTATO BUGS.

A correspondent, Mr. E. Wolff, has experimented on this question, and thus describes the results:

"I filled two flower pots with garden earth, mixing in the topsoil of one of them a pinch of Paris green; and I sowed in each about one hundred of canary and rape seeds, and plunged the pots side by side to the rim in the garden. The fourth and fifth day, all the seeds in the pure earth came up and are now growing lustily, while after the tenth day the seeds that had the Paris green with them show no sign of life, and are probably rotten. I am now making experiments with potatoes and other plants, but have not the slightest doubt that they will show the same results."

ANTIDOTE FOR ARSENIC.

Arsenic may be rendered inactive in the stomach by a dose of hydrated peroxide of iron, which is prepared by pouring a solution of green vitriol boiled with nitric acid, or of chloride of iron, into ammonia or soda, and washing the precipitate. Both arsenic and peroxide of iron can then be removed by the stomach pump or an emetic.

CONFLAGRATION OF COAL OIL.

To lessen the damage and save the oil, a correspondent, H. M. S., says: Let each floor where it is stored be divided into squares, sloping downward to the center so that, as each barrel bursts, its contents will run to the center, where they will be immediately extinguished and conducted to a place of safety by means of a siphon or S trap and pipe. That place of safety might be a large tank or cistern, even under the ground beneath the fire; but care should be taken that a pipe should lead off the air from the tank as it fills, which air, having become explosive, should be passed out through a gasometer, to prevent the fire from communicating with the air or gas in the tank. The amount which might be saved in insurance ought to provide the arrangement.

OZONE.—Houzeau, from a series of quantitative experiments, has come to the conclusion that country air contains one 450,000th of its weight, or one 700,000th of its volume, of ozone. He believes that its production is due to the continuous electrical discharges taking place between the earth and the clouds.