Agricultural Chemistry.

AIR.

We have seen that phosphorus will burn in oxygen with great brilliancy uniting with the oxygen to form an oxide of phosphorus. When phosphorus burns in the air it unites with the oxygen of the air to form the same compound. If the combustion takes place in a jar of air standing over water the phosphorus, if in sufficient quantity, will burn up all the oxygen and the water will rise in the jar to fill its place. It will be found that the water will now occupy one-fifth of the space formerly occupied by the air. The remaining four-fifths of the jar contain a gas, which, though not differing to the eye from oxygen or hydrogen; will neither burn nor support combustion. This gas is nitrogen and we see by this experiment that atmospheric air consists of four volumes of nitrogen and one volume of oxygen. More accurately air contains 21 volumes of oxygen, and 79 of nitrogen. Nitrogen can best be described by its negative properties. It has neither color, taste, nor smell. It is not combustible, and it does not support combustion. It will not support respiration, and animals placed in an atmosphere of pure nitrogen soon die, but it has no poisonous properties, and it may be breathed without injury. It is not quite so heavy as oxygen, but is fourteen times as heavy as hydrogen. In the air it serves to dilute the oxygen, which, if pure, would act with too much energy. Animals, as we have seen, would soon die in pure oxygen, but the atmosphere is exactly adapted to their condition, containing the oxygen, without which they could not exist, diluted by the nitrogen so as not to be injurious. The symbol of nitrogen is N.

The air is not a chemical compound but a mixture of the two gases which compose it. Chemical compounds differ in their properties from their constituents, but the air has all the properties which we should expect from a mixture of oxygen and hydrogen in the proportions in which we know them to exist in the atmosphere. The two gases, however, are always found in the same proportions. This depends upon what is called the *diffusion of gases*. If two gases are brought into contact they have a tendency to mix together and to remain so. This diffusion takes place even in opposition to gravity. So that if a jar of hydrogen be inverted over a jar of oxygen, although the oxygen is sixteen times as heavy as the hydrogen, it will rise into the upper jar, and the hydrogen will sink into the lower jar, until there is as much of each gas in one vessel as in the other. If it were not for this curious property, the oxygen in the atmosphere would all sink down to the earth's surface, and the nitrogen would float above it, and all its advantages as a diluent for the oxygen would be lost.

So perfect is this diffusion that air in the midst of large cities, where oxygen is constantly being taken from it in large quantities contains practically the same proportions of oxygen and nitrogen as the air of a mountain top.

Oxygen and nitrogen make up the great bulk of the atmosphere, but there are also found in it a variable amount of the *vapour of water*, a minute quantity of *carbonic acid*, and a trace of *ammonia*.

From the surface of the sea, and of every lake, river and pond on the surface of the earth, water is constantly ascending in the form of vapour into the atmosphere. This vapour diffuses itself through the air in obedience to the law that has just been stated. and consequently aqueous vapour is present in every part of the atmosphere. The quantity present depends greatly upon the temperature. The hotter the weather the greater the evaporation, but even on the coldest days this process is going on and vapour arises even from ice and snow.

At the close of a hot day the air becomes highly charged with moisture, and when such a day is succeeded by a cool night a portion of the aqueous vapour present in the air is deposited as dew. Clouds hinder the cooling of the earth, and hence the greatest quantity of dew falls on a clear night after a hot day. In the autumn when, although the days are warm, the nights are very cold, this moisture is frozen as it is deposited, and forms hoar frost. When plants are covered by a piece of matting or a board to protect them from the frost, these do so in exactly the same way as the clouds prevent the deposition of dew, by hindering the radiation of heat from the earth, and in this way preventing it from cooling down so much as it otherwise would do. When there is a considerable accumulation of aqueous vapour in the air it falls down as rain, snow or hail. The rain sinks into the ground from which it issues again in spring, and flowing thence into rivers and lakes is at length carried back into the sea, from which it originally came.

Plants exhale a large quantity of water from their leaves. A sunflower three feet high was found to give off from twenty to thirty ounces of water every twelve hours. The quantity of water exhaled by plants depends very much upon the temperature and upon the dryness of the atmosphere. The average amount of aqueous vapour present in the air is about one and a half per cent. by volume.

Air contains about 0·04 per cent. of *carbon dioxide*, or as it is commonly called *carbonic acid*. This substance is formed when carbon burns in oxygen or in air. It is also a product of the respiration of animals. It consists of 12 parts by weight or one atom of carbon in combination with 32 parts by weight or two atoms of oxygen and is represented by the formula CO_2. It may be readily obtained by acting on marble which is a *carbonate of lime* with hydro-chloric acid in the same apparatus which was used for hydrogen. It is a colorless gas with a peculiar pungent odor one and half times as heavy as air. If a lighted match be plunged into it the flame is instantly extinguished. Even when largely diluted with air it possesses this property of extinguishing flame. It is highly poisonous when breathed, producing suffocation. Hence, if it were not carried away by diffusion its presence in the atmosphere would be attended by most injurious results, as on account of its great weight it would accumulate at the surface of the earth particularly in towns where it is formed in large quantities, by the combustion of wood and coal which consists largely of carbon, and in respiration.

Animals exhale carbonic acid in breathing. Plants on the other hand absorb it from the atmosphere. It forms, indeed, an important portion of the food of plants. We see, thus, how the animal and vegetable kingdom, are dependent on one another, plants absorbing carbonic acid from the atmosphere and giving out oxygen, while animals absorb oxygen and give out carbonic acid.

Effect of Fertilizers in Different Seasons.

The editor of the *Boston Journal of Chemistry*, in giving the results of his farm operations the past season, says:—One of the most interesting facts which this extraordinary wet season has brought out is, that fertilizers applied to soils in dry summers without appreciable effects, are rendered available in those that are wet. The plats upon which our fertilizers have been applied during the past years, when the rainfall has been so deficient, produced wonderfully this season. The fertilizing substance have been lying dormant in the soil for the want of water to render them soluble or to hold them in solution, and this year the conditions have been favorable for promoting the changes, chemical and mechanical, necessary for plant food to be made available. Owing to the dry weather the past three years, it has been difficult to conduct experiments with manures, and reach anything like reliable results. Hundreds of farmers have been misled, and have condemned as worthless manurial substances which had positive value, but which needed the usual meteorological agencies to render them assimilable. Farm dung and stable manures, as well as chemical fertilizers, have not exerted their full influence upon soils to which they have been applied, because of the absence of rain. This season they have been thoroughly subjected to the action of water, and crops have been benefited by the dormant manurial agents applied two or three years ago. Manures are not lost which do not act promptly, unless they are blown away by winds, or are washed into brooks in sudden and violent showers, which sometimes fall upon the baked earth in summer. If they remain in or upon the soil, favorable seasons, which are sure to come, will force them to give up to plants the food they contain, and the husbandman receives his returns in abundant crops.

Entomological Department.

Insects of March.

The month of March is so uncertain in its character in this country, that one can never predict beforehand what weather we may expect, or even what work may be done; sometimes it is warm and genial like spring, with only occasional variations of light frost and soft snow; while another year it is rough, cold and tempestuous, rivalling January in its severity and adding the violence of equinoctial gales to the bitter frosts of winter. The animal as well as the vegetable creation is affected by the condition of the weather, and all the hybernating and migratory forms, with few exceptions, only make their appearance when the earth is renewing her verdure, and the sap is swelling the buds of the trees. Thus, then, we cannot say beforehand what birds or insects we may expect to meet with during this month, any more than we can say whether we shall be gathering shamrocks on St. Patrick's Day, or be sleigh-driving on All Fools'. In spite of the uncertainty, however, of this most fickle month we may venture to give a few hints regarding the insect world and the precautions that a careful farmer or gardener may wisely take.

FIG. 1.

On any pleasant warm days in March, the orchardist should go round his fruit trees and scrape off the loose bark from trunk and limb; by so doing he will get rid of many a Codling-Worm cocoon and other noxious insect; he should also be especially particular where he finds the tree affected by the injurious Bark Louse (Fig 1.), under the scales of which lie concealed the eggs of the next season's brood. This is work that may be done on any mild day, but for this operation should be selected a day when the sun is obscured, and there is no glare from sky or snow to affect the eye-sight.

The operation we allude to is the search for the egg-belts of the destructive Tent Caterpillars (Fig. 2.) and for the cocoons and eggs of the Tussock Moth. The former, as shown in the illustration, are deposited in the form of a bracelet or belt, to the number of two hundred or more, around the terminal shoots or twigs of a large number of our fruit and forest trees. They are laid by the parent moths, (*Clisiocampa Americana* and *C. Sylvatica*) in the middle of summer, and are protected from the weather by a thick leathery varnish. Before spring comes on and while the trees are destitute of foliage, they should be searched for on apple and other trees, and when found cut off or burnt. A little practice will soon enable one to detect them. A few hours devoted to this work now will save much time and loss later on in the season.

FIG. 2.

While searching for the egg-bracelets, notice should be taken of all dead leaves hanging on the apple, pear and many other fruit trees. These will be found on close inspection to contain in a majority of instances the empty cocoon of the Tussock Moth, enclosed in a coarse and loosely-woven web. A large number of these cocoons will be found to have upon them a hard white froth-like substance, which covers and protects a large mass of eggs. By gathering and burning the dead leaves the eggs from which a brood of destructive caterpillars would before long be hatched, will be effectually exterminated.

Any straw, loose boards, or other rubbish lying about the roots of fruit trees should be turned over and examined as the season advances; under them will often be found numbers of the cocoons of the Codling Moth, and caterpillars and insects of various kinds.

Towards the close of March, house-flies, bees and