have not to impart on this extraordinary and fatal disease. Fatal I much fear it will speedily prove in the case of the poor man now in hospital, on which I have addressed to you those few remarks.

COURSE
OF
LECTURES ON ORGANIC CHEMISTRY,
AS APPLIED TO
MANUFACTURES AND AGRICULTURE.

By M. PAYEN, Member of the Institute.

LECTURE III.

PRESERVATION OF TIMBER.—MANURE.

Cost of the Various Articles employed in the Preservation of Timber—Pyroligneous Acid and its Compounds—Sulphates, &c.

Nutrition of Vegetables—Assimilation of Carbon, Hydrogen, and Nitrogen—Humus—Theory of Manuring—Physical and Chemical Properties of Soils—Lime—Pyrites—Dried Blood.

GENTLEMEN,—Having, in my last lecture, explained to you the various methods employed for the preservation of timber, I shall now make you acquainted with the relative cost of the different materials so employed. The following numbers express the quantities of substances required to penetrate a beam (of oak, poplar, &c.) 18 to 21 feet long, and 11½ inches in diameter.* The pyrolignites are preferable to every other kind of salt, on account of their cheapness, and because they invariably contain an excess of creasote. The pyrolignite of iron obtained in forests is cheaper than the pyrolignite manufactured at a distance from growing timber; but as the former contains less creasote, the value of both is nearly the same. For example, the pyrolignite of iron manufactured by MM. Bobee and Lemire, at Choisy-le-Roi, marks 15° with the areometer, while that of forests generally marks 5°. Hence, 200 pounds of the forest pyrolignite at 5°, and costing 1s. 3d., will furnish the same results as 66 pounds of manufactured pyrolignite, which marks 15°, and costs about 2s. 8d. The price of the pyrolignite of lead found in commerce is much higher than that of the material just mentioned; 10 pounds are dissolved in 200 quarts of water, and the cost of the preservative solution amounts to 3s. 1d.

Pyroligneous acid, marking 7° with the areometer, has also been employed in the preservation of timber; 80 pounds are required, at a cost of 3s. 2½d.

Tar water, or, what is still better, the ammoniacal fluid resulting from the distillation of coal, and which is abundantly obtained in gas manufactories, may be employed in the proportion of 50 pounds; this gives a cost of 3s. 1d. for the preservative fluid. The bichloride of mercury is too costly a material, as I have already remarked, to be extensively used. Its action is very powerful; the quantity required is 0.8 of a pound, but this gives a cost of 8s.

To saturate a beam of timber, of the dimensions already given, with a solution of sea salt, would, likewise, cost about 8s., 50 pounds being the quantity requisite.

* The experiments which form the base of these calculations were made on 120 to 130 feet of timber; the mean results alone are given. Fresh timber absorbs 0.25 to 0.60 of its weight of fluid by forced imbibition.

Sulphate of zinc, the price of which is very valuable, has been employed in the proportion of 10 pounds. The sulphate of iron may also be employed in the same quantity; but when the timber has been saturated with the latter, it must afterwards be submitted to the action of oil, to prevent the decomposition of the sulphate into sulphuric acid and oxide of iron. The cost of the material is 8½d.

Many other substances are employed for the purpose of staining timber of different colors. Thus we obtain an ebony colored wood by first treating the timber with a solution of pyrolignite of lead, and then with a solution of the sulphate of sodium. The quantities are—

Acetate of lead	643 quarts.
	2037 quarts. 10 pounds.
Sulphate of sodium	201 quarts.
	290 quarts. 2½ pounds.

The above numbers signify that to make 2037 quarts of the solution of acetate of lead, we must employ 10 pounds of that salt; and 2½ pounds of sulphate of sodium for 491 quarts of its solution; that 643 quarts of the lead solution should be combined with 201 quarts of the solution of the sulphate, or 1394 quarts of the former with 290 of the latter. When a solution of the prussiate of potass has been introduced into timber and a solution of the sulphate of iron, we obtain a most beautiful Prussian blue color, which may be rendered still more brilliant by the addition of a small quantity of chlorine. The proportions are—

Ferro-cyanate of potass	666 quarts.
	1632 quarts. 10½ pounds.
Sulphate of iron . . .	840 quarts.
	675 quarts. 6½ pounds.

In like manner, if a solution of sulphate of copper is passed into the timber, and then a solution of ammonia, we obtain a very fine sky blue color; this mixture penetrates wood very readily. A solution of arsenious acid with a solution of acetate of copper gives a fine green tint, which becomes deeper on the addition of a small quantity of caustic potass. By varying these processes we can give wood a great variety of colors; but it is unnecessary for me to dwell any longer on this subject.

I shall now, Gentlemen, turn to the important question of the influence of manures on vegetation; but first allow me to say a few words on the nutrition of plants. Physiology, assisted by organic chemistry, teaches us the difference which exists between the mode of nutrition of plants and animals, and also points out the origin of carbon in plants, and the manner in which carbon, hydrogen, nitrogen, &c., are assimilated by them.

Vegetable growth takes place through the assimilation, by roots and leaves, of certain principles already prepared for plants by the hand of nature; while in animals different organs are required to operate certain changes in alimentary substances, and convert them into principles adapted for their nu-

trition. The moment we take up the theory of animal respiration, or endeavour to explain the assimilation of carbon by plants, we see at once that these questions embrace two of the most wonderful operations of nature—essential and effective causes of animal and vegetable life, which pursue an uninterrupted course, and will persist until the end of time.

One of the phenomena now alluded to is the constant proportion of oxygen contained in atmospheric air. When we reflect on the immense quantities of carbonic acid which are constantly being poured into the air which surrounds us,* we are naturally astonished at finding so feeble a proportion in the atmosphere and led to ask whither it goes—whence the constant proportion of oxygen contained in air at every period of time and in every country in the world? These questions are resolved by vegetable physiology. Plants possess the wonderful property of decomposing the carbonic acid contained in the atmosphere, and assimilating its carbon, and for each volume of carbonic acid thus reduced they yield an equal volume of oxygen. All doubt upon this point has been removed by the most accurate experiments, and it is now ascertained that the leaves and green parts of all plants absorb carbonic acid and exhale equal volumes of oxygen gas.† The air, then, contains the principal element of vegetable life, under the form of carbonic acid; water, also, contains another element, hydrogen, which we find on analysis in the cells of plants; and here I may mention that the tenacious matter of wood is more rich in hydrogen than is the celluline, a fact which explains why the best timber for burning is that which contains the greatest quantity of tenacious fibre; it also furnishes the greatest portion of acetic acid.

As I have already remarked, carbon is the element which is found most abundantly in vegetables. It is derived from the air. What, then, it may be asked, is the use of *humus*, which the earlier physiologists on the one hand, and agriculturists on the other, were in the habit of considering as the chief element of vegetable nutrition? For a long time the opinion prevailed that vegetable life depended exclusively on the formation of carbonic acid, and that this principle was furnished by the decomposition of *humus*; but modern researches have proved in the clearest manner the important influence exercised by nitrogen on the life and growth of the vegetable kingdom.

In the first place we may observe that nitrogen, which exists in more or less quantity in all vegetable cells, is essentially the *organising* principle, whereas the organised matter, the vegetable frame-work, or celluline, is composed of carbon, hydrogen, and oxygen only. The vegetable cell, in its earliest stage of formation, the embryonic envelopes and radicles, contain a considerable quantity of nitrogen. When submitted

to combustion these parts of plants, like animal matter, give out ammonia, which may be recognised by the alkaline vapor turning to blue reddened turn-sol paper; whereas pure celluline when burned gives out an acid vapor (pyroligneous acid). *Humus*, then, although derived from the decomposition of vegetable matter, can only be useful as a manure, in so far as it may contain a proportion of nitrogen; and the latter is principally furnished to plants in a state of combination with ammonia.

Rain-water always contains a small quantity of nitrogen; the rain which falls during summer, and particularly during thunder-storms, contains a larger proportion. M. Liebig has proved that, under the circumstances just mentioned, rain-water contains a protoxide of nitrogen in solution; and it is now well known that the "war of elements," indicated by the roar of thunder and the flash of lightning, gives rise to combinations of azotised substances which are transmitted from air to earth for the support of the vegetable kingdom. These storms are more frequent in summer than in winter; in warm more so than in temperate climates; they are particularly frequent in countries where the vegetation is excessively rich and the forest trees of immense magnitude. The hard wheat (*tritium durum*) of Africa, contains more gluten (an azotised substance) than the corn of more temperate climates. In a word, we cannot refuse to admit the connection between nitrogen and the nutrition of plants, or the great value of this substance as a principle of manure, without rejecting one of our most rational theories, founded on conclusive experiments and the results of experience.

Before I proceed to the more immediate subject of my lecture, it will be right to say a few words on the physical and chemical constitution of soils. We may remark in the first place, that the soil is a repository for the most delicate organs of vegetables; it should, therefore, be neither too compact nor too much broken up; neither too acid, nor too alkaline; earth slightly alkaline is, however, favorable to vegetation, and the good effects resulting from the mixture of a small excess of lime, even with calcareous soils, are well known.

The barrenness of some pyritic soils depends on the presence of a certain quantity of free acid; the sulphuret of iron which they contain is decomposed, and the acid destroys the roots of everything planted in them. Here the nature of the soil may be corrected, as is done in Picardy, by neutralising the acid with lime, and the opposite tendency may be corrected by the use of pyritic earth. Daily experience proves to us the injurious effects which result from the neighbourhood of manufactories giving forth acid vapors; the effects are often felt by the vegetable tribe at a distance of fifteen or twenty miles; it has also been observed, that the presence of too much carbonic acid in the air is injurious to plants; on the contrary, manufactories of ammoniacal products, or those which emit vapor containing nitrogen, exercise a beneficial influence on vegetable life.

These, and many other facts which I need not enumerate, prove that nitrogen is the principle on which the value of manure chiefly depends; and at the head of such manures I would place *dried blood*, an article extensively introduced into commerce during the last

* Each individual consumes 463 cubic feet of air in 24 hours, for the purposes of respiration; 58.112 cubic feet of oxygen are consumed during the combustion of half a ton of coal.

† It is a remarkable fact, which must have struck the notice of the least attentive observer, that the whole surface of such plants as are naturally deprived of leaves generally presents a green color; certain species of the cactus, &c., for example. The color depends on the presence of a peculiar matter, which seems to exercise an important influence on the respiration of plants.

years. Blood, when dried and reduced to powder, is of a reddish-brown color, very insoluble in water, and decomposes slowly, one of the essential conditions of good manure. If fresh fluid blood were applied to the roots of a plant, the rapid disengagement of ammonia would burn them up; but when mixed with a large quantity of water, and distributed by irrigation, it is one of the richest manures that can be employed by the agriculturist.

To prepare the blood, it is mixed with about one-eighth of water, and placed in a large boiler, heated by a coal fire, or, still better, by steam. The mass is stirred from time to time until the albumen is coagulated, and when this is completely effected, the blood is placed in sacks and submitted to powerful pressure for the purpose of expelling the serum; the mass is then dried in large vats by exposure to air. By mixing with it a certain proportion of carbonaceous matter, it acquires a tendency to undergo decomposition very slowly.

DIAGNOSIS OF INDIAN AND ENGLISH CHOLERA. CASE OF SPASMODIC CHOLERA.

TO THE EDITORS OF THE PROVINCIAL MEDICAL
JOURNAL.

GENTLEMEN,—The remarks made by your correspondent, Mr. West, on the letter you did me the honor to publish in your Journal of the 8th of October, relative to the diagnosis of English and Asiatic cholera, were, I think, neither called for by the letter nor the spirit of my communication, in which I stated "I had no desire to impugn the correctness of your very respectable correspondent's observations," as I was quite confident he would not publish anything he did not believe to be strictly true. My object was a purely scientific one, wishing to direct the attention of the profession to a most important subject, my mind having been turned to it by the perusal of Mr. West's cases. I must disclaim any intention to treat your correspondent with discourtesy, much less to insinuate that he would knowingly publish anything incorrect. Having thus endeavoured to set myself right with Mr. West, I will take leave to add a few additional remarks to my first communication.

There are three forms of cholera met with in this country—cholera biliosa, cholera flatulenta, and cholera spasmodica; the first common, the second rare, the last not infrequent, and often attended with dejections distinguished by an absence of bile, either from the circumstance of the extension of the spasms from the duodenum to the biliary ducts, shutting up the secretion in its receptacle, the gall-bladder, or from a washing out of the alimentary canal by the first evacuations, followed by an arrest of the hepatic secretion, as a consequence of the exhausted energy of the organic system of nerves. The first and third varieties are unquestionably the same disease, differing only in degree, the last owing its intensity to the concentration and more intense operation of the cause or causes which give rise to it.

With due deference to your correspondent, Mr. West, and other gentlemen who may think with him, I believe those isolated cases reported as Asiatic

cholera are not true specimens of the pestilential Asiatic cholera which spread so fatally in many parts of Europe, and in this country, in the years 1831-32, and which is the disorder universally understood by the appellation of Asiatic cholera, but the spasmodic cholera, as it appears frequently in temperate, but more often in intertropical, climates. Indeed, since the two varieties, the biliosa and spasmodica, have been from time immemorial known to occur both in temperate and intertropical countries, and occasionally so severe as to prove fatal, the term Asiatic can only apply to the pestilential variety of the disease.

That that variety of cholera now denominated spasmodic has been often observed in this country, as well as in other parts of Europe, for a very long period, medical literature sufficiently testifies. The epidemic described by Sydenham, as far back as the year 1669, was clearly of this kind; it was also well known to Cullen. Both these distinguished physicians describe it as occasionally destroying life in the short space of twenty-four hours.

The more I reflect on the subject of symptoms, the more I feel convinced of the little dependence that ought to be placed on the nature and appearance of the matters ejected from the alimentary passages, as distinguishing spasmodic from true Asiatic cholera.

The early medical writers paid too little attention to the nature of the animal fluids generally, and were not sufficiently acquainted with them to justify the moderns in placing implicit reliance upon their descriptions; and their vague notions of bile and biliary diseases are calculated to strengthen the doubt which cannot but arise in the mind from this view of the subject; but, if there be any faith to be placed in their statements on this head, there is to be found in their remarks sufficient to justify the opinion that the cholera they described was often accompanied with discharges from the stomach and bowels very different from bile. Cullen, who is the great authority for the bilious nature of the discharges, admits that they are not always so. Sydenham, in his account of symptoms, expresses himself thus equivocally—"Vehement vomiting, and difficult and painful dejections of ill-conditioned fluids." Celsus, on the same subject, observes, "*Bilis supra infraque erumpit; primum aquæ similis, deinde ut in eâ recens caro lota esse videatur; interdum alba, nonnumquam nigra vel vavia.*"*

As far as my observations enable me to judge, the alvine discharges, in cases of English cholera morbus, consist of a thin watery fluid, more or less, or scarcely at all colored with bile; indeed, it has appeared to me that the effect of the morbid cause upon the mucous membrane of the alimentary tube is analogous to a full dose of elaterium, and the evacuations not very dissimilar. But, prior to the occurrence of the true Indian cholera amongst us, the attention of medical men was not, I believe, sufficiently directed to this subject.

Even if the alarming reports of the nature and fatal tendency of the Asiatic cholera had not preceded its arrival in Sunderland in 1831, the peculiarity of its symptoms and course, with its astonishing attendant mortality, could scarcely have failed in soon convincing British practitioners that they had a disorder

* Lib. iv., sect. 11.