ISOLA BELLA.

A visit to Isola Bella was productive of less pleasure. It is far more expensive, but constructed with little taste, being a succession of terraces, with too great a predominance of brick and mortar. It reminds one of a fine piece of confectionary. There are, however, many interesting objects; *Cerasus caroliniana,* thirty feet high, and with foliage thirty feet in diameter; groves of oleander, eighteen feet high; Tree Box, thirty feet high; parterres; groves of *Magnolia grandiflora; Metrosideros alba,* twelve feet high, and eighteen in diameter of foliage; *Magnoliaii hartwg,* fifteen feet; *Arbutus unedo,* twenty feet; *Laurus camphora,* forty years old, and some fifty feet high; *Cunninghamia sinensis,* sixty feet; *Cupressus glauca pendula,* twenty feet; and a singular *Abies monocaulis,* forty-six years old, and ten feet high. One of the best things was a grotto, made to resemble the temple of peace, filled with ferns, kept damp by trickling water, and apparently supported by columns of ivy, five feet in diameter, and twenty-six feet long, which grew down from above, and, being detached at the bottom, would swing at a touch from the hand.

The collection in both these islands far surpassed that at the botanic garden of Pisa, and although not so large as that at Palermo, consisted of finer specimens, because less crowded.

The whole country about Lake Maggiore is full of delightful features, and in our pedestrian excursions among the mountains in search of bees there frequently burst upon us scenes of wonderful beauty. The quiet charm of the lake was always present, and we would sometimes walk over stretches of turf like an English lawn, or skirt along copses of underwood, fresh with the peculiar beauty of young vegetation. At one time old trees, with broad arms, would shelter us, and then we would be wandering amid the trained gracefulness of a vineyard, while an occasional mountain torrent, foaming and dashing, would leap across our path.

To visit Italy and not see the Italian Lakes, is to look at a frame and not see the picture. But the nations were gathering to the battle, troops were hastening forward, and, bearing in mind that in war there was lawlessness, we hastened to place the Alps between the combatants and our defenseless party.

FERTILIZERS.

BY HON. THOS. G. CLEMSON, L.L. D.

From the day when the *fiat* went forth, "In the sweat of thy face shalt thou eat bread," agriculture took its place among the arts of the world. It is true, while population was sparse, and man depended first on game and then on flocks and herds, this art made little or no progress. The tropical climate, where the infancy of man seems to have

been cradled, would appear also to have led him to defer the necessity of much attention to it. Very soon, however, the increasing density of population must have necessitated its development, since we find that the Egyptians, at the earliest period to which history reaches, were *already* skillful agriculturists, and had carried the art to such a point of perfection as not only to have sustained their own dense population, but to have made Egypt the granary of the world. That it was not entirely the fertility of that favored region to which this was due, we have evidence in the present state of that country. The Nile still overflows the land with fatness, and the sun still sheds its vivifying influence; yet, there, agriculture has sunk to its lowest ebb, and the country scarce supports its miserable tribes; its immense world-renowned monuments alone remain to show what the land once was. Egypt is the most striking proof which history presents of the inseparable connection between a high state of civilization and a high development of agricultural resources. They rise and fall together, and the prosperity and, indeed, existence of the one is identical with the other. Let that nation beware, whose exhausted fields are forcing her population to emigrate. Civilization, in its highest degree, cannot exist without dense population; nor dense population, without calling to its aid the highest resources of agriculture.

Egypt stands a living, or rather a dead, type of the intimate connection between population and agriculture. China is one equally striking, on the opposite side. For how many thousand years has her pains-taking care for every foot of her soil maintained her prosperous and dense legions, in a region comparatively but little favored by Nature, and given a respectable position among nations to a people but little intellectually gifted! How many wonderful discoveries do we owe to the necessities of their compact masses! The struggle for existence has always been one of the greatest stimulus to the activity of the human mind.

This continuous prosperity, through a long series of centuries, is owing to the sedulous care of the government. No people, left to themselves, will think of future generations; and it is for that reason that all governments should foster and aid the development of this most important of arts, as government only can. This is so well understood in the present day, by all nations, that those who govern are turning their attention daily more and more to its aid and advancement. England has done so by direct legislation; her aristocracy, also an integral part of her government, having, consequently, the weight necessary to carry out a continuous system, has given all the impetus of this weight and their great wealth to its energetic development.

It is only within comparatively few years that science has revealed to us the true composition of bodies and the laws that govern their action; thus developing the wonderful resources of Nature, and reducing that to system which, in the time of our forefathers, was ignorant practice based upon hereditary experience.

It is true that this subject has occupied, from the earliest times, the attention of statesmen, philosophers, and philanthropists; but they only collected and reasoned from the results of experience, without entering into the laws which led to and governed the results which they recorded. Agriculture, therefore, now stands upon a basis far different from what it has hitherto occupied; and not working, as we have heretofore, in the dark, but knowing *where to look* for causes and effects, we may expect in the next century to make a stride that will give to this art, or rather convocation of arts, a place among the exact sciences. But this very rapidity of advancement will render it more fatal to be left behind in the race; and neither nations nor individuals can stand supinely by, depending upon the past, and exhausting the accumulated resources of Nature, without individual and national ruin. Death is the award of improvidence, to nations as well as to individuals. The continuous march of civilization to the west was the natural result of ignorance; and the civilized world is just beginning to realize the dire consequences that are pending over those who neglect to act upon the unerring laws which science reveals. Sterility and depopulation are consequences not of use, but of abuse. Disappearance of man and all his monuments, even to the entire extinction of vitality, is the consequence of mistaken cupidity, or the ignorance of those laws which govern scientific agriculture. Indeed, that essential art needs no *protection*; we may safely leave to enlightened industry, especially in our country, the application of proper and well-proved rules. That which is necessary, however, is to place within the reach of all the experience of the world, and the important results which science and observation are constantly developing, that time may not be lost in futile and oft-tried experiments. Government, indeed, alone would seem capable of establishing and persisting in a continuous system of improvement and development, not only for this, but future generations. Its influence and weight are essential on the side of advancement.

One of the most interesting and important subjects to the agriculturist is, of course, the means of keeping up, or restoring the fertility of his land; and that he may not work in the dark, it is essential that he should understand the nature and action of soils, the functions of plants, and the operation of fertilizers.

It is important we should always bear in mind that this earth is not a heterogeneous mixture of an indefinite number of illy-defined substances, but, on the contrary, the different objects or forms of matter which present themselves to our senses are limited in the number of their constituents; as far as our knowledge extends they do not exceed sixty-two.

Each substance is *sui generis*, and, no matter from whence taken, possesses precisely similar properties, and is governed by invariable laws in its action upon other substances. They are solid, liquid, or aeriform, according to circumstances. Water is a familiar example; it is solid in the form of ice, liquid in water, and aeriform as steam.

Substances have been created once and forever; they may change place, form, and combinations, but such a thing as blotting out of existence, or re-creation, is impossible. Some are abundant, while others are exceedingly rare, and difficult to procure. To show the small or limited number of substances which enter into the bodies around us, it is only necessary to remember that the great mineral masses, which form by far the largest portion of the earth, are composed, as far as our knowledge extends, of a few elementary principles. Water is composed of two gases, and the air we breathe likewise of two gases, one of which is common alike to air and water. Nor do they combine in an indefinite manner; they unite with each other in simple, definite proportions, multiples the one of the other, and the quantity rarely surpasses the proportion of five to one. Substances may be, it is true, heterogeneously *mixed* in any proportions, and these mixtures present endless varieties, but are not chemical compounds, and do not enter into the category of which we are speaking.

Matter may be divided into that which has life, and that which is without life. The principal part of the substances which go to compose organic beings exists around us, in the air we breathe, (water, carbonic acid, nitrogen.) There are other substances not less essential to organic life, but which are found to enter their composition in infinitely smaller quantities. These are found in the ashes, after incineration of any vegetable or animal matter. We shall learn their composition as we proceed.

Those things which are endowed with vitality are produced, then increase, and mature. Inorganic substances increase by the juxtaposition of similar parts, and their form is destroyed by forces exterior to themselves, while organisms reproduce their like, and have a period of existence determined by laws, which fix their time of growth, decay, and death. Of organic life there are two distinct classes, one receiving its food through a digestive canal, and is endowed with locomotion; the other is fixed by roots to the soil. This is not rigorously correct, but sufficiently so for our present purpose. The last, or vegetable productions, receive a portion of their food through their roots, and another through their leaves. The root answers a double purpose, that of fixing the plant in the earth, and drawing from it nourishment. Vegetable anatomy informs us that among the elements of their construction there are cells, which are found in all plants, whatever character they may have, and those cells, by transformations and successive development, form fibres, tubes, or elongated canals. While the characteristics of the animal and vegetable classes are thus marked, the qualitative chemical composition of both is identical; the principal organic portions of which—I do not allude to the mineral constituents, or ash, and there is great similarity in that respect—may be said to express the condensation of the gases of which they are composed. Oxygen, hydrogen, carbon, and nitrogen form the volatile portions; and silex, lime, potash, soda, magnesia, iron, sulphur, and phosphorus the mineral parts. It is mainly with those substances that we have to deal in connection with fertility or agriculture. If we can turn a never-ceasing influx of them into our fields, the problem of fertility is solved, and it remains for us to consider their properties, their history, their action the one upon the other, and the means that have heretofore been employed of making them subservient to our wants.

Plants are divided into two distinct classes, those that receive their increment from within and those that receive their growth on the exterior. The first are called endogens, the latter exogens. All organized bodies have forms and properties peculiar and inherent to themselves, and those forms and properties characterize the parts as well as the whole; and it is that particular form and the properties of the parts that render it what it is and make it a living thing. Some plants go through the different stages of germination, growth, fructification, and death in one season; they are called annuals. Others live through a succession of years, and are called perennial. Some of the minute fungi, on the contrary, go through the stages of their existence in a few hours, and seldom live longer than a few days. Some plants are annuals in a northern latitude, but perennial in a more southern. The oak, the yew, the cypress, and cedar are long-lived trees, and flourish for many centuries. Some remarkable instances of the longevity of trees are noted by historians. A yew tree, which was growing in 1660 in the county of Kent, in England, about which all tradition was lost, measured at that time very nearly sixty feet in circumference at the base, and is believed to have been 2,880 years old. On the island of Nerbuddah, in Hindostan, there is still standing a banyan; the tradition of the natives is that it is 3,000 years old. A species of cypress, which grew near Oaxaca, in Mexico, and which is said to have sheltered the whole army of Cortez, measured nearly 118 feet in circumference, or 37¼ feet in diameter, and was computed by Decandolle to have withstood the deluge and been in existence before the creation of man. There is another cypress at Chapultepec, in the same region, which is said to be 117 feet 10 inches round. If the measurement here given be correct, and the tree consists of one stem, we are entitled to consider the Mexican cypress as the most gigantic and ancient tree discovered on the globe.

No infallible rule is known by which we can estimate the age of trees. The known practice of counting the concentric rings in the trunk of a tree, and reckoning each for a year, is liable to error, for a recurrence of cold after warm weather may so check vegetation as to occasion the formation of two layers in one season, or two zones may be fused into one by some temporary injury. But it is nevertheless a close approximation, and may be relied on within certain limits.

It is through the roots that the ash or mineral ingredient enters, while the leaves absorb from the atmosphere the organic or combustible portion. The power of assimilation appears to be dependent upon the action of light. A plant placed in water containing carbonic acid, and exposed to the light of the sun, absorbs the acid and gives off oxygen. At night the action is reversed, and carbonic acid is emitted, when oxygen is assimilated. Every one has remarked the tendency of plants to lean towards the sun, and where they are kept in cellars they will bend even several feet from the perpendicular to receive the rays of light that may enter through an aperture. In the early stages of plant-life, the carbon of the soil enters through the roots; but when the plant has risen above the ground, and its leaves are formed, the carbon of the soil is no longer needed, and it is probable that what is required is entirely assimilated from the carbonic acid of the atmosphere.

The sap rises from the roots through the internal vessels to the leaves, becomes carbonized by the decomposition of the carbonic acid of the atmosphere, and passes down into the plant, forming ligneous fiber, &c. We shall not enter into the subject of vegetable physiology; that would be foreign to our purpose. Fertility depends at once upon the chemical composition and mechanical condition of the soil; nor can it be independent of subsoil and climatic influences. The latter question, including the chemistry of ozone, is one of great intricacy. It is so interwoven with heat, electricity, moisture, and chemical reaction as almost to baffle investigation. Plants generate and evolve heat, and possess the power of preventing their juices from freezing at a degree of temperature far below that at which congelation would take place were the plant dead. Fertility is a relative term, and is dependent upon multifarious influences. A certain degree of heat and moisture is essential to life; without them, there can be no germination nor maturation of seed; nor are these essentials independent of soil, or rather its constituents, we may say one constituent, for the absence or presence of one substance may secure fertility or produce sterility.

With these preliminary remarks, we pass to the consideration of water in its connection with fertility:

Water in a perfectly pure state is composed of two volumes of hydrogen gas and one of oxygen, and about 89 parts of oxygen and 11 of hydrogen by weight. When you mix the two gases they will remain uncombined for an indefinite period, unless the mixture should be submitted to the action of heat or electricity. The combination then takes place with the manifestation of stupendous force. The two components may be separated by electricity. Water enters into the composition of all vegetable and animal structures. It is one of the principal constituents of blood, milk, and sap. By its assistance, silex and other insoluble substances enter into circulation, and are assimilated by animals and vegetables. It is found to make part of all grains, woods, leaves, &c. Its absence would produce universal death. It enters into all our domestic operations, and forms part of all alcoholic beverages and articles of food. It is essential to production, and it may be said that fertility in any locality is in direct proportion to humidity, and sterility in proportion to its absence. The truth of this proposition is verified in a remarkable degree in the deserts of Sahara and the western plains of this continent.

Water is never obtained pure from natural sources; it is procured by distillation. That which issues from springs, generally contains mineral substances, and always impurities of a gaseous nature. There are waters, even river waters, that at times evaporate without residuum. Such is the case with that of the Schuylkill, at Philadelphia. We have used it for months together, in analysis. Rain-water, and that which falls in the form of dew, are also impure. The former, though much freer from impurities than that which has flowed over the ground, comes down charged with all the impurities of the atmosphere, which it washes as it descends. These substances are varied and numerous, consisting of impalpable sand, vegetable and animal particles, also salt taken up from the ocean. That which first falls after a drought is often charged with the offensive odor of animal perspiration, excrements, and putrefaction. It also brings down fishes and frogs, and at times organisms and pollen, to the extent of tinging the surface of the earth with the color of the adventitious matter. Rain-water always contains ammonia and nitric acid. These are partly formed by the action of electricity in the atmosphere, and are partly the result of decompositions which take place on the surface of the earth and in the air.

Pure water is insipid and unhealthy. That taken from springs or rivers, independent of any mineral ingredients which it may hold in solution, always contains a quantity of oxygen gas, the great supporter of life and combustion. This imparts a tonic-invigorating quality to cold water, which when boiled it does not possess; to the latter, emetic qualities are attributed. Water, from its known quality of containing oxygen in weak combination or in an evanescent form, together with carbonic acid, is a powerful and essential agent in chemical action, which is ever occurring in the soil, &c. The substances held in solution vary in different rivers and different parts of the same stream, both in kind and in proportions of the saline ingredients. The following analysis of water from different rivers were made by some of the most distinguished chemists of continental Europe, Bouchardat, Boussingault, Dupasquier, Tingry, Grundaub, and Payen:

"For example, 100,000 parts of the water of the Seine above Paris contain 11.3 of carbonate of lime, 0.4 of carbonate of magnesia, 0.5 of silica, 3.6 of gypsum, 0.6 of Epsom salt, 1.0 of chloride of calcium, 0.8 of chloride of magnesium, and traces of nitrates and of organic matter; 100,000 parts of the water of the Marne contain 10.5 of carbonate of lime, 0.9 of carbonate of magnesia, 0.6 of silica, 3.1 of gypsum, 1.2 of Epsom salt, 1.7 of chloride of magnesium, and traces of organic matter; 100,000 parts of the water of the Ourcq, at St. Denis, contain 17.5 of carbonate of lime, 2.0 of carbonate of magnesia, 2.0 of silica, 15.3 of gypsum, 7.0 of Epsom salt, 4.0 of chloride of magnesium, and traces of common salt and of organic matter; 100,000 parts of the water of the Yonne, at Avallon, contain 4.3 of carbonate of lime, 1.9 of silica, traces of gypsum, 1.5 of chloride of calcium, and traces of common salt and organic matter; 100,000 parts of the water of the Benvronne contain 25.7 per cent. of carbonate of lime, 20.3 of gypsum, and 8.5 of chloride of calcium; 100,000 parts of the water of the Thérouenne contain 26.2 of carbonate of lime, 2.0 of gypsum, and 3.6 of chloride of calcium; 100,000 parts of the water of the Gergogne contain 18.0 of carbonate of lime, 1.5 of gypsum, 1.5 of chloride of calcium, and 1.9 of common salt; 100,000 parts of the water of the Bièvre, near Paris, contain 13.6 of carbonate of lime, 25.1 of gypsum, 10.9 of chloride of calcium, and 1.2 of common salt; 100,000 parts of the water of the Arcueil contain 16.9 of carbonate of lime, 16.9 of gypsum, 11.0 of chloride of calcium, and 1.9 of common salt; 100,000 parts of the water of the spring of Roye, at Lyons, contain 23.8 of carbonate of lime, traces of silica, 1.4 of gypsum, 1.2 of common salt, and traces of nitrates and organic matter; 100,000 parts of the water of the Fountain Spring, at Lyons, contain 23.4 of carbonate of lime, traces of silica, 1.7 of gypsum, 1.3 of chloride of calcium, traces of chloride of magnesium, 0.2 of common salt, and traces of organic matter; 100,000 parts of the water of the Rhone, at Lyons, in July, contain 10.0 of carbonate of lime, traces of silica, 0.6 of gypsum, and traces of Epsom salt, of chloride of calcium, of chloride of magnesium, of common salt, and of organic matter; 100,000 parts of the water of the Rhone, at Lyons, in February, contain 15.0 of carbonate of lime, 2.0 of gypsum, 0.7 of Epsom salt, 0.7 of chloride of calcium, and traces of nitrate of lime and of organic matter; 100,000 parts of the water of the spring of the Garden of Plants, at Lyons, contain 27.0 of carbonate of lime, 25.2 of gypsum, 16.8 of carbonate of calcium, 1.6 of chloride of magnesium, 12.6 of common salt, 7.6 of nitrates, and traces of organic matter; 100,000 parts of the water of the Lake of Geneva contain 7.2 of carbonate of lime, 0.7 of carbonate of magnesia, 0.1 of silica, 2.6 of gypsum, 3.1 of Epsom salt, 0.9 of chloride of magnesium, and 0.6 of organic matter; 100,000 parts of the water of the Arve, in August, contain 5.2 of carbonate of lime, 0.4 of carbonate of magnesia, 0.1 of silica, 3.2 of gypsum, 2.9 of Epsom salt, 0.7 of chloride of magnesium, and 0.3 of organic matter; 100,000 parts of the water of the Arve, in February, contain 8.3 of carbonate of lime, 1.2 of carbonate of magnesia, 0.2 of silica, 6.5 of gypsum, 6.2 of Epsom salt, 1.5 of chloride of magnesium, and 0.4 of organic matter; 100,000 parts of the water of the Loire, near Orleans, contain 1.7 of carbonate of lime, 5.1 of chloride of calcium, and traces of common salt; 100,000 parts of the water of the Loiret contain 11.9 of carbonate of lime, 3.8 of gypsum, 10.2 of chloride of calcium, and 2.5 of common salt; and 100,000 parts of the water of the artesian well at Grenelle, near Paris, contain 6.8 of carbonate of lime, 1.42 of carbonate of magnesia, 2.90 of bicarbonate of potash, 1.2 of sulphate of potash, 1.09 of chloride of potassium, 0.57 of silica, and 0.24 of nitrogenous organic matter."

It will be borne in mind that the above-named substances are in solution and do not include those held in mechanical suspension. The waters analyzed above are not only limpid, but such as are used for the kitchen and all the daily purposes of life.

Much has been written upon the sewerage of cities throughout the world. This is a subject of great importance, not only to the agricultural wealth of the country, but imminent to its sanitary condition. The value that is daily washed into rivulets from our lands, and thence to the sea, is incalculable. Mr. Grey, in speaking of the Medloch, says: "it receives the drainage of not more than 100,000, and contains sufficient phosphoric acid to supply 95,000 acres of wheat, 184,000 acres of potatoes, or 280,000 acres of oats, and to hold in solution a sufficient quantity of silica to supply 50,000 acres of wheat."

A distinguished agricultural writer in 1845 makes the following remarks upon the subject of the sewerage of London:

"By carefully conducted experiments and very accurate gaugings it has been found that the chief London sewers convey daily into the Thames about 115,000 tons of mixed drainage, consisting on an average computation of one part of solid and twenty-five absolutely fluid matters; but if we only allow one part in thirty of this immense mass to be composed of solid substances, then we have the large quantity of more than 3,800 of solid manure daily poured into the river from London alone, consisting principally of excrements, soot, and the debris of the London streets, which is chiefly carbonate of lime; thus, allowing twenty tons