[For the Scientific American.]

SEASONAL BEHAVIOR OF PLANTS.

It has for some time been supposed that the heat of spring acts more powerfully or promptly upon plants in higher than in lower latitudes. De Candolle attempted to test this by planting, in some intermediate locality, seeds of several common annuals, taken from different latitudes. With the exception of one species of seeds, which one confirmed his opinions, he had in this way but indifferent success, owing probably to the fact that most of the seeds from the different latitudes represented unlike forms of variable species. It then occurred to him to make the trial with trees instead of seeds. Accordingly, in the early part of 1875, he sent for branches of four species of trees from Montpellier, and paired them with similar branches from Geneva. After subjecting them to the same degree of heat till all acquired the same temperature, he placed the pairs in glasses of wet sand in a warm room under exactly the same conditions. When these developed buds and leaves in the spring, he found that all the slips from the northern locality arrived at the same stage of vernation earlier by from 18 to 23 days than those in the southern locality.

Two interesting considerations grow out of these facts, one of them practical and the other scientific in character. If these are facts, universal in their application, it will become a matter of considerable practical value in preparing vegetable products for market at the earliest possible moment. The great profits on many products of the soil depend largely upon their early introduction into market, when the demand is great and the supply small. If, by introducing seeds or plants from a northern locality, the gardener or fruit grower can make his crop ready for the market two or three weeks earlier, the advantages of such a course will not long remain unimproved. It is only necessary, by actual and sufficiently exhaustive experiment, to establish the truth of this theory in its application to all our seeds and plants, to gain for it universal acceptance.

In point of scientific interest appears the question why the same temperature acts more effectually upon the plant from the more northerly locality. De Candolle gives two answers to this query. First, that it may be due to natural selection of the buds. The earliest or most precocious have the advantage in the struggle for existence, while the latter ones are stifled. "In this way comes a selection and a successive adaptation of the tree to the climate." In connection with this, he furnishes incidental information respecting reversion. To illustrate the theory that the above result is accomplished because "every peculiarity of a bud is ordinarily reproduced year after year in the succeeding growth," he cites the case of a horse chestnut tree near Geneva, which, about the year 1822, first produced a single branch that bore double flowers, and has ever since borne nothing but double flowers, showing no tendency to revert to the single-flowered condition. This branch is supposed to be the origin of all the double-flowered horse chestnuts in the world, all others having been propagated from it by grafts.

The second reason why the northern plant develops, with the same temperature, more rapidly than the southern, is that the winter repose of the former is more complete than the latter; which, opines De Candolle, in some unaccountable way renders it more susceptible to the heat of spring. De Candolle attributes most importance to the latter explanation, while Dr. Asa Gray, in his comments, seems to incline to the former rather than to the latter.

The average time of the flowering of spring plants has been of late attracting considerable attention in Scotland. The Scottish Meteorological Society and the Botanical Society of Edinburgh have both been collecting data upon this subject. Both collections of facts have in view the advancement of meteorological science. The former society has given attention, for the past twenty years, to facts relating to the budding, leafing, flowering, and defoliation of trees and plants, and to the migrations of birds, in connection with the periodical return of the seasons. The material here brought together on this interesting subject has not yet been worked up so as to exhibit results; and before this is undertaken, it was decided to discuss the observations of Mr. McNab on the flowering of 32 spring plants in the open air in the Royal Botanical Garden of Edinburgh, during the past twenty-six years. These observations have been published in the "Transactions of the Edinburgh Botanical Society."

Mr. McNab's observations resulted in finding that the average time of flowering of the 32 plants taken had, during the twenty-six years, ranged in different species from January 25 to April 1, and later. He finds that the spring of different years varies considerably in the time of opening, it being sometimes thirty days later than the average, and again twenty-three days earlier: thus making a difference of fifty-three days between the earliest and latest springs during the twenty-six years. This average is obtained from observations on all the 32 plants; but when particular flowers are taken, the deviations from the mean are still greater. The greater deviations occur before the time of the equinox, when the time of flowering is often from five to seven weeks earlier or later than the mean. Unusually mild or severe weather before the time of flowering, as would be expected, greatly disturbs the plant in its season of æstivation, yet it affects some plants more than others. For example, in 1864, when the preceding December was remarkably mild, and the following January and February colder than usual, one species of blue-eyed grass (*sisyrinchium*), whose mean time of flowering was eleven days earlier than that of *daphne*, flowered eighty-six days before the latter. When such disturbances occur, of course no computed mean can be relied on, unless it be from data gained by observations recorded through a long series of years.

In Edinburgh, the mean temperature falls till January 11, and then slowly rises. Before the end of February, nearly half the 32 plants have flowered; and the very gradual rise in temperature to that time "suggests that it is not so much absolute temperature as the accumulated amounts of the preceding daily temperature, in the extent to which these rise above freezing."

If interest in this work can be sufficiently excited to prompt to the taking of observations similar to the above in other sections of the globe outside of Edinburgh and Scotland, we may expect results, in the science of meteorology, which will be not only most interesting but most profitable. We shall doubtless learn how closely the science of botany is related to that of meteorology, and how much insight we may gain into the intricacies of temperature and climatic influences by knowing the mean time of the flowering of plants in widely separated localities.

Another interesting matter, closely connected with the above, is the relation of color to the time of flowering of plants otherwise similar. Of the 32 plants observed by Mr. McNab, three were the blue, white, and red varieties of the species *scilla bifolia*. Of these, he found that the blue flowered first, and on the average ten days before the white, and the latter, four days before the red: making the difference of two weeks between the flowering time of two varieties of the same species, differing from each other only in color. The British wild flowers, to the number of 909 species, have been grouped according to their color and the month in which the flowers open. The results are very similar to those obtained by Mr. McNab. The order of colors in their average time of flowering is found to be, from earliest to latest, blue, white, purple, yellow, red, etc.

That the order of colors in spring flowers is from the outer colors of the spectrum to the inner has been several times observed by parties independent of each other; but others, in making like observations, have failed to see this order. Of course, to reach satisfactory conclusions on this point, an exhaustive study must be made upon all the colors of all the flowers, and the general average taken. Such exhaustive observations, continued from year to year for a long time, can hardly fail to result in very valuable knowledge as to the relative vitalizing power of the sun's rays in different seasons of the year, which will probably be available as well in the study of animal as of vegetable life. This also has a practical application in the rearing of early and late varieties of flowers and fruits.

It has been suggested that experiments be tried by excluding from the flower those colors of the sun's rays which the flower itself presents, in order to see what effect it would have upon the color and locality of the flower. In reply, it has been suggested that the reflected light would probably have less effect upon the plant than the absorbed light, and hence the object might possibly be best attained by excluding the colors complementary to those reflected.

Askenasy and others have experimented with flowers provided with sufficient food, but excluded entirely from light, and found that some changed their color and others did not. Mr. J. C. Costems suggests that the color may become almost constant by continued inheritance during a long lapse of time, and, consequently, be unaffected by the change of a few weeks or months. H. C. Sorby obtained results similar to Askenasy's, and concluded that "growing flowers in the dark seems to stop the normal development, to a greater or less extent, according to the nature of the coloring matters, the effect being greatest in the case of those substances which are the most easily decomposed."

An intimate connection has been observed between the seasonal order of color in flowers and the seeming "erratic behavior of certain radiometers." These eccentricities, observed in things so dissimilar as the color of flowers and the movements of radiometers, both affected by light, may lead us still further onward toward the eventual discovery of some new, or rather hitherto unknown, property or form of force existing in light. S. H. T.

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THE BLESSINGS OF GUNPOWDER.

All inventions, of whatever kind, belonging to any period of man's existence on the earth, have proceeded from his wants; or as it is stated in the characteristic proverb: "Necessity is the mother of invention." It is indeed a fact that history, ancient as well as modern, proves the truth, first forcibly brought out by Darwin, that the mightiest cause of progress has always been, with man as well as with the whole vegetable and animal kingdom, the struggle for existence and the survival of the fittest. This struggle has not only improved individual man from his originally savage condition to that of civilization and finally to enlighten ment, but, on a larger scale, has also served to promote the progress of nationalities, which has extinguished the weaks er and less intellectual races of mankind, and exalted the stronger and more intellectual. This struggle for national superiority, which in its final result proves which are the really superior races, institutes, in its widest sense, war. In ancient barbarous and semi-barbarous times, bodily strength was the only superiority recognized, because it conferred on the possessor the means of compelling from others recognition and obedience; and hence in olden time the foremost leaders were always men of powerful frames, who could enforce obedience. This state of things lasted until the world was blessed with the invention of gunpowder, which equalized the power of individual men, as the bullet fired by a small man is as mortal as the bullet fired by a giant. It made an end to oppression of the weak by the strong, and even gave the weak and small some advantage, as the chance of being hit by a ball is larger in proportion to the size of the individual, and *vice versâ*.

The general introduction of gunpowder for purposes of defence was the most powerful cause of the downfall of feudalism, that curse of the middle ages, when the weak and poor had not only to work for the strong and rich, but to submit to the most glaring injustice. It was gunpowder which changed all that, because physical strength no longer gave entire superiority to its possessor, and the powerful soon found that he had to practise justice, even to the lowest and feeblest of his neighbors and dependants. Gunpowder, then, has wrought the great social change which resulted in the lawful protection of the weak; and as necessity is the mother of invention, it is no wonder that this valuable invention was due to that state of society in which the most urgent wants are created, namely, a general war or struggle for superiority. This is a grand subject of contemplation for the deepest philosophical minds.

The saying that "gunpowder is the greatest civilizer" is therefore a profound truth. It is certain that that wonderful ancient nation, the Chinese, who knew it many centuries before the European peoples, had some degree of civilization at a period when Europe was still plunged into barbarism. At that time the Chinese had a perfect right to consider other nations as outside barbarians; and these nations made no considerable progress until gunpowder came into extensive use in warfare. Gunpowder at once put an end to the barbarous and demoralizing hand-to-hand fights, and has thus made wars less ferocious and less destructive, as it decides battles with far less destruction of life than was formerly the case. Even the improved appliances of the present day, the cannon of enormous size, the *mitrailleuses*, Gatling guns, needle guns, breech-loading rifles, etc., murderous as they look, and able to kill many men in a shorter time before, have, strange to say, an effect contrary to the theory, by which they would naturally be supposed to have the result of augmenting the list of victims in battles. Statistics of all the recent battles in which these appliances were used have indeed shown a much reduced slaughter of human beings, in proportion to the number engaged, than was the case in battles fought before these apparently very destructive and murderous inventions were adopted.

The greatest enemy in war is, at the present day, sickness, as was shown in the Crimean war, our Southern war, etc. Disease, indeed, has carried off or disabled more men than lead. But since chemical and mechanical ingenuity has conferred the blessings of gunpowder and improved firearms upon the world, it is now the business of physiological and medical science to apply knowledge and skill, and devise means of introducing sanitary measures to preserve the health of the soldier, and to reform the treatment of the sick so as to reduce mortality in the hospitals to a minimum: for as we have stated, the mortality by battles is, on an average, notwithstanding that appearances point the other way, less than that by disease in the hospitals.

It is a subject of just national pride that many of the measures taken by the staff of our military health officers has been so proper and effective that they have excited the admiration of all the world, and been imitated and introduced by several European nations. The principal cause of this, we should state, is that, according to the acknowledgment of the heads of this department, their plans were not thwarted by interference by non-medical superiors, as is the case in European armies. Our medical staff has an independent existence, enjoying the direct support of the United States government, which gives it *carte blanche* to carry out its own views on the important functions it is called upon to perform. How effectively and honestly this has been done, and the confidence placed in the medical officers been justified, the history of our war fully and conclusively proves. *

A New Dye Stuff.

Ch. Lauth has succeeded in producing another new class of dyes by the introduction of sulphur into aromatic diamines, and then oxidizing the new sulphur compound. On heating phenylen-diamine (made from nitro-acetic anilide) with sulphur, to 150° or 180° C. (300° or 356° Fah.), sulphuretted hydrogen gas is evolved, and a new base containing sulphur is formed. This base is converted by oxidizing agents into a beautiful violet dye.

The same substance can be obtained in a more simple manner by dissolving the muriate of phenyl-diamine in a large quantity of sulphuretted hydrogen water, and slowly adding sesquichloride of iron. The precipitate formed is washed with a weak salt solution and recrystallized from hot water. In the dry state this dye consists of very fine curved and intricate needles of dark green luster. It is soluble in pure water, but foreign substances change its solubility; with caustic soda it yields a brown precipitate, probably the free base. Reducing agents destroy the color of the violet substance; oxidizing agents destroy it quite quickly. Like the ordinary aniline dyes, it may be modified by substitution; with aniline it produces a blue dye insoluble in water; with aldehyde or iodide of methyl it gives a green, which attaches itself directly to the fibers. Cresylen-diamide from nitrated ortho-acetoluidin gives, under similar conditions, more of a reddish violet; cresylen-diamine, corresponding to paratoluidin, gives a violet red. These new dyes contain sulphur.

CEMENT FOR WOOD VESSELS REQUIRED TO BE WATER-TIGHT.—A mixture of lime clay and oxide of iron separately calcined and reduced to powder, intimately mixed, kept in a close vessel, and mixed with water when used.