The average duration of vitality in seeds of some of our cultivated plants is as follows: Artichoke, five years; broad bean, six: beet root, five; cabbage, five; carrot, four; cucumber, five; lettuce, five; maize, two; melon, five; onion, two; parsnip, two; peas, four or five; radish, five; spinach, five; tomato, five; turnip, five; egg plant, seven; endive, nine; parsley, three; strawberry, three. An analysis of these figures shows a general agreement in the constitution of the seeds of different plants of the same families, with exceptions which can be accounted for in the way already explained. Exalbuminous seeds, and those with very little albumen, retain their vegetative power longer than seeds with a minute embryo and a relatively large quantity of albumen. Taking a broader survey, the rule holds good that the more highly developed embryo, whether small in itself or large, will lie longer dormant without losing life than the large or small embryo of albuminous seeds. Sir Joseph Hooker has stated that the seed of *Nelumbium speciosum*, taken from a herbarium known to be upwards of one hundred years old, germinated. This seed has an exceedingly dense testa.

FORMATION OF AMERICAN COAL.

The base of our coal measures is a rock, called the great conglomerate, which is chiefly composed of white, water-worn pebbles. Its composition proves it to have been the bed of an ancient sea; and that a great sea existed in the eastern half of our continent is a fact well known to geologists, who have traced it from the Rocky Mountains to the Blue Ridge. In this wide expanse of water the coal deposits of our country were formed beyond a doubt. It was a wise provision of nature to lay for their base the thick and strong conglomerate rock, as the violence of volcanic action in that early period was so great that a weaker barrier would have been broken, and the coal would have been destroyed by denudation. The 200,000 square miles of American coal are divided, by Prof. Rogers, into five great fields, of which the first, or eastern, includes the coal deposits of Newfoundland, Nova Scotia, Cape Breton, and New Brunswick. The second, or Alleghany coal field, is the largest, and extends from Pennsylvania and Ohio, southwestward, into Georgia, and includes the anthracite fields of eastern Pennsylvania. The third is a small field, known as the northern, occupying the central part of Michigan; and the fourth is the central field, including parts of Illinois, Indiana, and Kentucky. The fifth or western field, lies west of the Mississippi, principally in Iowa and Missouri, but extends into Arkansas.

Besides these well defined fields, we have, further west, the uncertain deposits of the Black Hills; but as the thickness of the American coal measures regularly decreases from east to west, the seams that may be found on the eastern slope of the Rocky Mountains must be very thin and scarcely workable. In the east, where the coal formation is thickest, there are in all about fifty seams, but not half of them are of sufficient thickness to be worked. In Nova Scotia only five are of workable dimensions, and these produce about twenty-five feet of coal. In the anthracite region, the number of productive seams is about twenty-five, and they average in some sixty feet of coal, but their maximum yield is somewhat over a hundred feet. The largest of the anthracite veins is the "Mammoth," which is thirty feet thick. In the Alleghany region the average thickness of workable seams is about half that of the anthracite fields; and in the western fields it is only about ten feet. Thus the number of seams, and the quantity of coal, decrease from east to west; as also the thickness of the intervening strata of rock. The greatest depth of the coal measures, including these strata, is 3,000 feet.

It is supposed that coal was formed during the carboniferous era, when the earth and the atmosphere were in a condition to produce an unlimited and gigantic growth of vegetation.

That the coal beds had their origin during this vast vegetable growth, is a well attested fact; but the process by which the carbon and bitumen of that rank vegetation were concentrated and solidified, is a point on which scientists differ. The fact that there is no sign of vegetation in pure coal, indicates that the component parts have been expelled by heat or pressure, in the form of oil. If accumulated vegetation or woody fiber had formed coal, it would doubtless be fossiliferous. It seems natural, therefore, that the enormous oil deposits of the carboniferous era, resulting not only from resinous vegetation, but also from the countless myriads of marine animals, when accumulated in localities having the requisite conditions, formed beds of coal. Great quantities of this oil were evidently sealed between rocky strata, and thus kept from solidifying, for want of exposure; and from these reservoirs issue the numerous oil springs of the present day. Herodotus, more than two thousand years ago, referred to a spring on one of the Ionian Islands, which is still flowing. The Chinese *Hotsing*, or wells of fire, are gaseous petroleum springs, and are made of much practical service in evaporating salt water. There is a similar spring in Fredonia, New York, south of Lake Erie, the gas of which is used for lighting the town. Genoa and Parma, in the north of Italy, are similarly lighted. In Cuba petroleum springs are very numerous; and between the fissures of rocks it has consolidated in the form of bitumen, which is used for fuel. When petroleum is thus solidified by exposure to a moderate heat, it bears a strong resemblance to bituminous coal; but under a higher temperature, the hydrogen and oxygen are evaporated, leaving a comparatively pure carbon, resembling anthracite; and when subjected to an intense heat, the carbon is also vaporized, leaving only the impurities.

The best anthracite coal contains about ninety per cent of carbon, which is rendered gaseous by the ordinary process of combustion. From these facts we may infer that the various kinds of coal are due to different degrees of heat to which they were exposed during formation. The oily cannel coal was evidently formed with little heat, the ordinary bituminous with more, while the hard anthracite was subjected to such a degree of heat as left it nearly a pure carbon.

Oil being lighter than water, it readily accumulates on the surface of lakes, and on long exposure it forms a sheet of bitumen, or pitch, which in winter is hard, so that a man can walk on it with safety. There is such a lake on the island of Trinidad, one of the West Indies; and similar lakes are known to exist in other volcanic regions. Hence, during the periods of vegetable and animal oils, and of extraordinary volcanic activity, producing, no doubt, an abundance of oil directly from mineral sources, it is reasonable to suppose that immense bodies of water were thus covered to a great depth with plastic coal. The time of such formation necessarily corresponded with a period of volcanic inactivity. While forming, the sheet may have been occasionally sprinkled with a slight shower of ashes, causing an impurity in the coal, such as slate or bone; and a rent in the sheet, caused by contraction, may account for the fact that the miner sometimes suddenly loses the vein, and must grope for it through the rock. When volcanic action revived, the greatest imaginable changes must have taken place, to account for the strata of rock overlying the seam. Between some of the seams the stratum is over two hundred feet thick. Showers of ashes or streams of lava may have sunk the sheet to the bottom, when, during the next period of inactivity, another seam may have been formed to be submerged in like manner, but perhaps with a stratum of only a few feet in thickness.

That these strata decrease in thickness from east to west, may be attributed to the well known geological fact that volcanic activity was greatest in the eastern section of our continent; and as the seams decrease in like manner, we may infer that coal owes its origin chiefly to volcanic sources.—*By Moses Zweizig, in Christian Weekly.*

PLANTS OF THE CARBONIFEROUS PERIOD.

NEW USE FOR CYPRUS REED STEMS.

Mr. John R. Jackson, of the British Museum, referring, in the *Gardener's Chronicle*, to the enormous trade now carried on in London in the manufacture of walking sticks and parasol handles, says that, notwithstanding the large number of these useful and ornamental articles that are constantly being produced, and the consequent demand for certain kinds of sticks, there is every now and then a utilization of something quite new, and different from anything that has hitherto preceded it. Such, for example, was the discovery and adaptation of the fasciated stems of the fuller's teasel, which some two years since were imported in vast numbers from France for the sole purpose of converting into parasol handles. At a recent meeting of the Linnæan Society specimens of a newly introduced cane were exhibited both in the rough and finished states. These canes were at first thought to be derived from a species of bamboo—*Bambusa nana*—and hence received the trade name of "Nana"; but it was afterwards discovered that they were from the Cyprus reed (*Arundo donax*). The peculiarity which has caused them to be taken up for the purpose to which they are now applied lies in the irregular and fantastic forms of the rhizomes, and especially in the ring-like ridges which encircle these rhizomes at regular intervals. Owing to the combined form, surface markings, and natural yellow tint, which harmonizes so well with the coverings used, a more unique handle for a parasol could hardly be produced. These articles have now become quite the rage, and may be seen in large numbers in the show windows of fashionable stores. The Cyprus reed is a robust grass, growing fifteen feet or more in height, with abundant leaves and very large terminal panicles of a brownish white color. It is found in southern Europe, eastern Asia, and on this continent in Texas and Mexico, and is apparently the reed mentioned in Scripture. The uses to which the plant has hitherto been applied are as supports for vines, for fishing rods, etc.

Functions of the Air Bladder in Fish.

In a paper read at a recent meeting of the Cotteswold Naturalists' Field Club, by Mr. Francis Day, the author remarks that few among the organs in fishes have been the cause of so much discussion as the air bladder, which is a single or variously divided sac, situated beneath the vertebral column and the kidneys, and placed above the center of gravity. As this organ is sometimes present or absent in species of the same genus, it is evident that it is not entirely indispensable to the fish's existence. It originates as an offshoot from the stomach, elongates, and then enlarges at its extremity into what is termed an air bladder. In the dipnoids the air bladder communicates with the œsophagus during life, and its functions are analogous to those of lungs. In *Amia*, a ganoid fish, it has also a lung-like function, but in *Acipenser* it is used merely for hydrostatic purposes. The air bladders, however, are not considered as lungs in most fishes, since the blood is supplied to them from the adjacent arteries, and in many cases returns as venous blood into the circulation. In *Lepidosiren*, however, in consequence of the non-development of gills on the two inferior branchial arches, the blood is not arterialized there, but passes on to the air bladder for this purpose. The lepidosirens are doubtless the highest known form of living fishes. The chief use of the air bladder in teleostean fishes is (1) hydrostatic; (2) acoustic, it being partially or entirely employed for hearing by means of various modes of connection with the internal ear.

In the *Physostomi* the air bladder occurs as a closed sac. In the marine forms of these orders a tubular prolongation itself passes forward to the anterior portion of the skull to establish an auditory communication, but in the fresh water species the connection is formed by a chain of auditory ossicles. In conclusion, Mr. Day says that the air bladders in fishes is the homologue of the superior vertebrate forms, and that in some of the higher sub-classes it serves as an accessory respiratory organ.

Amplifying Small Motions.

At a recent meeting of the London Physical Society Mr. Ridout exhibited a device for amplifying small motions. A small barrel is slung by two threads between the prongs of a metal fork in such a manner that if the fork is bodily carried to and fro the barrel will rotate round its axis. This is simply effected by making each thread, in its passage from one prong to the other, take a few turns round the barrel. To the barrel an index is attached, and the fork is then fixed on the body whose minute motion is to be indicated. The translation of the body shifts the fork and rotates the barrel, which in turn deflects the index round the face of a dial, and the magnifying power is expressed by the ratio of the diameter of the barrel to the length of the index. With this apparatus Mr. Ridout exhibited the lengthening of an iron core when magnetized by the passage of the current of two Grove's cells through an insulated wire coiled round it. By riveting a slip of brass to the iron the unequal expansion of brass and iron under heat was also shown, the heat being generated by keeping the current flowing in the coil.

Mr. D. Winstanley exhibited his new radiograph for recording graphically the intensity of solar radiation throughout the day. It consists of a differential thermometer, with one black bulb and a circular stem. The lower part of the stem is filled with mercury; the upper branches with sulphuric acid and water. The tube is mounted on a brass wheel, so that when the black bulb is exposed to the sun's rays the differential motion of the mercury causes the wheel to turn. The wheel carries a light index or marker, which is free to traverse a vertical cylinder covered with paper coated with lamp-black, and leaves a white track where its point has scratched off the soot. The radiogram thus produced can be fixed and preserved.