battery. The magnet was made by Mr. Nesbit. . . . The greatest weight sustained by the magnet in these experiments is $12\frac{3}{4}$ hundredweight, or 1,386 pounds, which was accomplished by sixteen pairs of plates, in four groups of four pairs in series each. The lifting-power by nineteen pairs in series was considerably less than by ten pairs in series, and but very little greater than that given by one cell or one pair only. This is somewhat remarkable, and shows how easily we may be led to waste the magnetic powers of batteries by an injudicious arrangement of its elements." [1]

At the date of Sturgeon's work the laws governing the flow of electric currents in wires were still obscure. Ohm's epoch-making enunciation of the law of the electric circuit appeared in "Poggendorf's Annalen" in the very year of Sturgeon's discovery, 1825; though his complete book appeared only in 1827, and his work, translated by Dr. Francis into English, only appeared (in Taylor's "Scientific Memoirs," vol. ii.) in 1841. Without the guidance of Ohm's law, it was not strange that even the most able experimenters should not understand the relations between battery and circuit which would give them the best effects. These had to be found by the painful method of trial and failure. Pre-eminent among those who tried was Professor Joseph Henry, then of the Albany Institute in New York, later of Princeton, N.J., who succeeded in effecting an important improvement. In 1828, led on by a study of the "multiplier" (or galvanometer), he proposed to apply to electro-magnetic apparatus the device of winding them with a spiral coil of wire "closely turned on itself," the wire being of copper from one-fortieth to one-twenty-fifth of an inch in diameter, covered with silk. In 1831 he thus describes [2] the results of his experiments:—

"A round piece of iron about a quarter of an inch in diameter was bent into the usual form of a horseshoe; and instead of loosely coiling around it a few feet of wire, as is usually described, it was tightly wound with 35 feet of wire covered with silk, so as to form about 400 turns. A pair of small galvanic plates, which could be dipped into a tumbler of diluted acid, was soldered to the ends of the wire, and the whole mounted on a stand. With these small plates, the horseshoe became much more powerfully magnetic than another of the same size and wound in the same manner, by the application of a battery composed of 28 plates of copper and zinc, each 8 inches square. Another convenient form of this apparatus was contrived by winding a straight bar of iron, 9 inches long, with 35 feet of wire, and supporting it horizontally on a small cup of copper containing a cylinder of zinc. When this cup, which served the double purpose of a stand and the galvanic element, was filled with dilute acid, the bar became a portable electro-magnet. These articles were exhibited to the institute in March, 1829. The idea afterwards occurred to me that a sufficient quantity of galvanism was furnished by the two small plates to develop, by means of the coil, a much greater magnetic power in a larger piece of iron. To test this, a cylindrical bar of iron, half an inch in diameter, and about 10 inches long, was bent into the shape of a horseshoe, and wound with 30 feet of wire. With a pair of plates containing only $2\frac{1}{2}$ square inches of zinc, it lifted 15 pounds avoirdupois. At the same time a very material improvement in the formation of the coil suggested itself to me on reading a more detailed account of Professor Schweigger's galvanometer, which was also tested with complete success upon the same horseshoe. It consisted in using several strands of wire, each covered with silk, instead of one. Agreeably to this construction, a second wire, of the same length as the first, was wound over it, and the ends soldered to the zinc and copper in such a manner that the galvanic current might circulate in the same direction in both; or, in other words, that the two wires might act as one. The effect by this addition was doubled, as the horseshoe, with the same plates before used, now supported 28 pounds.

"With a pair of plates 4 inches by 6 inches, it lifted 39 pounds, or more than fifty times its own weight.

"These experiments conclusively proved that a great development of magnetism could be effected by a very small galvanic element, and also that the power of the coil was materially increased by multiplying the number of wires without increasing the number of each." [1]

[1] Sturgeon's Scientific Researches, p. 188.

[2] Silliman's American Journal of Science, January, 1831, xix. p. 400.

[1] Scientific Writings of Joseph Henry, p. 39.

NOTES AND NEWS.

THE well known writer on vegetable paleontology, Professor E. Weiss of Berlin, died on July 5 last.

— The annual meeting of the American Folk-Lore Society will be held Nov. 28 and 29, 1890, at Columbia College, New York. A preliminary meeting for the purpose of organizing a local committee of arrangements was held at Room 15, Hamilton Hall, Columbia College, 49th Street and Madison Avenue, on Wednesday, Oct. 8, at 4 P.M

—We learn from the *Medical and Surgical Reporter* of Oct. 4 that there were registered in the second trimester 908 foreigners who were studying medicine in France, of whom 822 were in Paris. Of the latter there were, from Russia, 261; the United States, 159; Roumania, 85; Turkey, 71; England, 51; Spain, 34; Greece, 34; Switzerland, 25; Servia, 20; Portugal, 18; Egypt, 13; Italy, 12; Bulgaria, 8; Austria, 7; Belgium, 7; and Holland, 60.

— By the death of Professor Carnelley the science of chemistry in England has suffered an irreparable loss. It appears, as we learn from *Nature*, that some little time ago Dr. Carnelley had been suffering from an attack of influenza, and it was while returning to Aberdeen after a journey to the south, made with the object of recruiting his health, that he was seized with sudden and severe illness, which was due, as his medical attendants discovered, to the formation of an internal abscess. Surgical aid proved unavailing, the patient's strength gradually gave way, and Dr. Carnelley passed away at mid-day of Aug. 27, at the comparatively early age of thirty-eight.

—The report of Dr. Eitel, inspector of schools in Hong Kong, for the past year, contains some interesting details. According to *Nature*, the total number of educational institutions of all descriptions, known to have been at work in the colony of Hong Kong during the year 1889, amounts to 211 schools, with a grand total of 9,681 scholars under instruction. More than three fourths of the whole number of scholars, viz., 7,659, attended schools (106 in number) subject to government supervision, and either established or aided by the government. The remainder, with 2,022 scholars, are private institutions, entirely independent of government supervision, and receiving no aid from public funds. The total number of schools subject to direct supervision and annual examination by the inspector of schools amounted, in 1389, to 104, as compared with 50 in 1879, and 19 in 1869. The total number of scholars enrolled in this same class of schools during 1889 amounted to 7,107, as compared with 3,460 in 1879, and 942 in 1869: in other words, there has been an increase of 31 schools and 2,518 scholars during the ten years from 1869 to 1879, and an increase of 54 schools and 3,647 scholars during the ten years from 1879 to 1889. It would seem, therefore, that the decennial increase of schools and scholars during the last twenty years has shown a tendency to keep up with the progressive increase of population. Comparing the statistics of individual years, the number of schools under supervision and examination by the inspector of schools rose from 94 in 1887, and 97 in 1888, to 104 in 1889, while the number of scholars under instruction in these same schools rose from 5,974 in 1887, and 6,258 in 1888, to 7,107 in 1889. There is, therefore, a steady annual increase during the last three years, progressing from an increase of 284 scholars in 1888 to an increase of 849 in 1889. The expenses incurred by the government during the year 1889, on account of education in general, amounted, exclusive of the cost of new school-buildings, to a total of $53,901.

—Mr. E. Nevill, the government chemist at Natal, in his last report to the colonial secretary, notes that valuable deposits of argentiferous galeno of copper and of bismuth exist in the colony, and of such rich nature that they could be profitably exported in bulk. In both Alexandra and Umvoti Counties, as stated in *Nature* of Sept. 25, deposits of silver-bearing lead ore have been found containing from ten to fifteen pounds' worth of silver per ton of lead ore. Saltpetre has been found so rich as to be worth more than three times as much as the best Peruvian deposits. Plumbago, asbestos, and the mineral phosphates appear to be of inferior quality. Several calcareous formations have been examined, which are likely, under proper treatment, to yield good hydraulic cement.

—Some chemical re-actions can be started or accelerated by sunlight, and an increased effect is to be expected where the rays are concentrated by a lens or concave mirror. Herr Brühl has described experiments made in this way, in production of zinc ethyl from zinc and ethyl iodide,—a re action difficult to start. As given in *Nature*, the retort, containing zinc filings and several hundred grams of ethyl iodide, was placed at the focus of a concave mirror, about a foot in diameter, receiving the sun's rays. The re-action soon began, and grew so vigorous that cooling was necessary. In a quarter of an hour all the ethyl iodide was conconsumed, and, through the subsequent distillation in an oil-bath, a good yield of zinc ethyl was had. This radiation process, it is suggested, might be variously useful in actions on halogen-compounds, which tend to be disaggregated by sunlight A lens, owing to the athermanous property of glass, wguld be less powerful.

—Lord Rayleigh has recently had under observation, says *Engineering* of Sept. 26, some cases of defective color-vision which prove, what seems only natural, that we cannot simply distinguish trichromic and dichromic color-vision, as has sometimes been done. Normal color-vision is trichromic; color-blind people have dichromic vision. If we have black, white, blue, red, green, we can match two against three. For dichromic vision we want only four colors; for instance, those mentioned without white. For ordinary purposes the wool test will suffice: if not, we recur to spinning disks,—two concentric disks, the one over the other, the inner one consisting of sectors of different colors, the outer one showing ring portions. The disks are made of colored cardboard, and have a radial slit, so that we can make up any combination we like; e.g., 10 parts of black + 45 white + 35 green, 100 making the total circumference. Sometimes patients prove obstinate, and will not say when they consider the inner and outer disk matches. Such are examined by means of an older apparatus of Lord Rayleigh's, a color-box with a revolving Nicol. Here they often commit themselves, and discover differences of brightness only, where there are evident differences of color. As an example of a peculiar match, Lord Rayleigh gave the following: 64 green + 36 blue = 61 black + 39 white, that is, a green-blue against a gray; another, 82 red + 18 blue (crimson) = 22 green + 78 blue. But such people are not always consistent in their way: they will make certain matches, but refuse to acknowledge others which appear suited for them. One case, for instance, first thought to be dichromic, finally proved not to be so; the sensibility for red not being altogether absent, but only impaired. Such cases have been little studied as yet. Lord Rayleigh further referred at the meeting of the British Association, at which his paper was delivered, to Maxwell's color-triangle, and the position of the black and the dark spot.

— The last two numbers of *Cosmos* contain some very interesting information on various topics. Some new discoveries have been made at Pompeii, near the Stabiana Gate, and a description is given of them. *Nature* states that three bodies were found, two being those of men, and the third that of a woman. Not far from the resting-place of these bodies was found the trunk of a tree, 3 metres in height, and measuring 40 centimetres in diameter. This tree, together with its fruits that were found with it, have been examined by the professor of botany, M. Pasquale, who finds in it a variety of *Laurus nobilis*. By means of the fruits, since they come to maturity in the autumn, he concludes that the eruption did not take place in August, but in November.

— It was observed a short time ago by Dr. Kremser, says *Nature* of Sept. 25, that the curve of mortality in North Germany lagged about two months behind that of the variability of temperature. An inquiry into this matter in the case of Budapesth has been lately made by Dr. Hegyfoky, taking the nine years 1873–81. Comparing the months, he failed to make out a certain connection; but taking into account other meteorological elements besides temperature, and reckoning by seasons, he found the variability of weather in the different seasons to give the following order from maximum to minimum: winter, spring, autumn, summer. As regards mortality, the order was spring, summer, winter, autumn. Thus it appears there is a displacement of three months. If a connection of the kind referred to really exists between weather and mortality, the effect (mortality) must appear somewhat later than the cause (variation of weather).

—We learn from *Engineering* of Sept. 26 that the Forth Bridge has been for some time entirely completed, the works have been dismantled, and the engineers' staff and the workmen have had to seek new fields of operation, some of the engineers having gone to Mexico, America, Greece, and India. The finishing touch, it is interesting to note, is the only thing in the way of ornament on the bridge, all else being indispensable parts of the structure. This embellishment consists of two brass plates placed on the south cantilever pier, in commemoration of the opening of the bridge by the Prince of Wales on March 4, 1890. The names of the directors, engineers, and contractors are also given. Sir John Fowler has had fitted at the end of the south main span, at which point the contraction and expansion joint is placed, an indicator to record the number of trains passing and the daily contraction or expansion of the bridge. The apparatus consists of a brass rod, with a pencil, attached to the end of the girder, and a clock with another brass rod fixed in its axle. Round the rod in the axle of the clock is wound a strip of paper about four inches wide, with a weight attached to the end. The point of the pencil rests on this paper, which is, of course, constantly on the move as the clock winds down. The result is, that as the cantilever contracts, the pencil attached to it is pulled away; when it expands, the pencil is pushed forward; and a curve of contraction and expansion is thus produced by the movement of paper and pencil combined. The same principle is applied to register the behavior of the bridge while a train is passing. When the train enters on the one end of the cantilever, it pulls the far-off end down; and when it does so, it also pulls the pencil, and thus a mark at right angles to the curve of contraction and expansion is made. When it passes to the other half of the cantilever, it pushes it forward, and again a mark at right angles to the curve is made on the other side. Each mark indicates a train, and thus the simple apparatus serves three purposes. The management are troubled a good deal with requests for passes to inspect the bridge; but as walking over the bridge, owing to the narrowness of the sidewalk, is attended with considerable danger, very few are granted. The speed of the trains in crossing the bridge is not now limited, except in the case of goods trains, and with them it must not exceed twenty-five miles an hour. As there are only about two feet six inches between the pedestrian on the bridge and the flying train, it is seen that the precaution is wise. The average traffic on the bridge amounts to about one hundred and forty trains daily.