arrow. As fast as the ring enters the space $a\,b\,c$, it becomes red-hot and non-magnetic, and a lack of equilibrium is thus maintained which results in a continuous rotation.

The motion is necessarily quite slow on account of the considerable time required to heat the iron ring. In the actual experiment, moreover, considerable difficulty was experienced from the distortion which the ring underwent when softened by the heat, in consequence of which the speed of rotation became very irregular. With a permanent steel magnet, a speed of about one revolution in two minutes was obtained; and with a powerful electro-magnet, a weight of six grams was raised fifty centimetres in six minutes, and, in a second experiment (the ring having become quite distorted), ninety centimetres in thirty minutes.

Of course, the source of energy is the Bunsen burners; and the experiment leads at once to the fact, that the specific heat of magnetized iron is greater than that of unmagnetized. CHAS. K. MCGEE.

University of Michigan,
Ann Arbor, Feb. 19.

Congenital deafness in animals.

The communication of Professor Bell in No. 54 of *Science*, in reference to Mr. Lawson Tait's statement that no other animals than cats are affected with congenital deafness, calls to my mind the fact, that in my early boyhood I had a dog which was thus afflicted. I got him when a puppy; and, so far as we could determine, he was never able to distinguish any sounds. He was of the breed usually known as 'fist,' and, so far as my memory serves me, was of a yellow color: certainly he was not pure white. What renders this instance the more interesting, is the further fact, that a playmate of mine also had a deaf dog. I think he was of the same family, but not, I believe, of the same litter. That congenital deafness should be rare among wild animals, I can readily understand, since, in the struggle for existence, their defect would lead to an early extinction; but under domestication, where their conditions approach more nearly to those of man, I can see no reason why a defect of physical organization should not be transmitted by inheritance, as I believe it to have been in the cases above cited. It is a fact well known to aurists, that in some families there is a tendency to become hard of hearing, or even deaf, at about the same age; owing, doubtless, to certain evolutions which take place in their physical structure at that time. SWAN M. BURNETT, M.D.

Washington, Feb. 22.

A singular optical phenomenon.

The windows of our office are provided with fly-screens having the ordinary mesh of something less than an eighth of an inch. Thirty feet across the way is a building whose windows are protected by a coarse screen having a mesh a little less than half an inch in size. Standing about ten feet back from and looking through the fly-screen at the coarse screen, an inverted, magnified image of the latter is seen in mid-air, between the observer and the fly-screen; the inversion, of course, being only detected by the apparent movement made by the image on changing the position of the eyes. The explanation of the phenomenon is not difficult. The lines of the coarse screen throw nominally a single ray of light, which is inverted through the particular mesh of the fly-screen directly in line with it and the observer. Any other substance, such as a paper wad introduced in the coarse screen, will not appear in the image. It may not be uninteresting to mention in this connection the fact, that while a short-sighted person, to whom I endeavored to show the same phenomenon in my home, using as an object the slats of a blind in a house a hundred and fifty feet away, was unable to see the actual slats, owing to their remoteness, their image was distinctly visible to her. F. J. S.

Deflective effect of the earth's rotation.

In a letter of mine, published in *Science*, ii. No. 26, I suggested that the deflecting force produced by the rotation of the earth on bodies moving on its surface is not wholly represented by the rotation of a tangent plane, but depends, in part, on the centrifugal force resulting from the body's relative motion in longitude, and is therefore greatest when the motion is perpendicular to the meridian.

That my suggestion is *not* true, and that the force is the *same* for all directions of the motion, may be demonstrated very simply, as follows:—

From the proposition announced in section 25 of Peirce's 'Analytical mechanics,' it follows that any tangent plane whose latitude is λ rotates about an axis normal to that plane with an angular velocity equal to ω cosec. λ, ω denoting the angular velocity of the earth about its polar axis.

Therefore if P represent the point where the normal axis pierces the surface of the sphere, and if a body be caused to move in any direction over the point P with a velocity v, it will, by the rotation of the tangent plane, be constrained to describe in space the spiral of Archimedes, whose equation is $u = a\theta$; and when $\theta = 2\pi$, $u = v$ multiplied by the time of one rotation of the tangent plane. Hence, if one hour be the unit of time, $u = 24\,v$ cosec. λ; and $\frac{1}{2}a$, = the radius of curvature at the origin of the spiral, $= 6\,v \div \pi \sin\lambda$.

Now, the deflecting force at P is equal to the centrifugal force due the velocity v at the origin of the spiral, which is represented by $v^2 \div \frac{1}{2}a$:

$$\therefore f = \tfrac{1}{6}\,v\,\pi \sin\lambda.$$

But the centrifugal force, $V^2 \div R$, due the rotation of the earth at the equator, is known to be $\frac{1}{289}mg$; mg denoting the weight of the body, and $V = \frac{1}{12}\pi R$:

$$\therefore f : \tfrac{1}{289}\,mg :: \tfrac{1}{6}\,v\,\pi \sin\lambda : V^2 \div R;$$

whence, substituting for V^2, we get,

$$f = \frac{\frac{1}{289}\,mg\;24\,v \sin\lambda}{\pi R}.$$

The centrifugal force resulting from the body's relative motion in longitude affects only the origin of the spiral, and not at all its elements, and hence has no influence on the value of f: consequently f is the total deflecting force, and is independent of the direction of the motion. J. E. HENDRICKS.

Des Moines, Io., Feb. 14.

A carboniferous genus of sharks still living.

I observe that in a late number of *Science*, Mr. Garman describes a new genus of sharks from the Japanese seas, under the name of Chlamydoselachus. The figure of the teeth which he gives shows the animal characterized by Mr. Garman to be a species of the genus Didymodus (Cope, Proceedings Philadelphia Academy, 1883, p. 108, equal to Diplodus Agass. Poiss. fossiles, pre-occupied in recent fishes), which has hitherto been supposed to be confined to the carboniferous and Permian periods. The species possess two, three, or four denticles. Material in my possession enables me to fix the position of this genus, which I will endeavor to explain in the next (April) number of the *American naturalist*. Didymodus becomes by this discovery the oldest living type of vertebrata. E. D. COPE.

Philadelphia, Feb. 28.

Artificial production of rain.

I give below an instance which came under my own observation, of the artificial production of rain, which may be interesting, read in connection with the article in *Science*, No. 55.

Many years ago, during my residence in Virginia, the whole of the eastern portion of that state had been suffering one summer from a long-continued drought. For several months not enough rain had fallen at any one time to moisten the ground to the depth of half an inch. The atmosphere was gray, and full of dust. The sun, even at noonday, was 'shorn of his beams,' and could be looked at directly without paining the eyes. The temperature was not unusually high; but the weather was very oppressive, being what is called in the country, 'muggy.' One of my neighbors had several months before cut down, and left lying where it fell, a young forest of scrub pines from a field of about forty acres in extent. These pines had, of course, become, during the long drought, completely dry. One August morning, the meteorological conditions remaining exactly as they had been for months before, my neighbor caused fire to be set to this clearing at several points on the circumference at the same time. The fire ran over the whole tract with wonderful rapidity. An immense column of inky smoke rose perpendicularly (there was no wind) to a great height. Upon reaching a stratum of air of its own density, the black column spread out horizontally into the form of a gigantic mushroom, rapidly changed color from jet black to gray, and soon thunder was heard in the top of the ascending and spreading column. The fuel was gradually consumed, and the smoke ceased; but the cloud continued to spread, and rain began to fall in a little more than an hour from the time the clearing was fired.

The thunder gradually ceased; but rain continued to fall until sunset, when the sky cleared. For the remainder of the season, showers and rain-storms occurred with ordinary frequency, as if the conditions favorable to the continuance of the drought had been permanently broken up. Observations of temperature, the dew-point, and of the barometer, would have been valuable; but I had unfortunately no instruments at hand for obtaining them.

While the artificial production of rain can have no economical importance, — depending, as it necessarily must, upon many meteorological conditions, which, to be effectual, must be synchronous, — yet an example of a rainfall of several hours' duration, which was undoubtedly produced by an ascending column of heated air artificially supplied, seems worthy of record. L.

Annual growth of the 'Tree of heaven.'

I have in the cabinet of Cumberland university two remarkable shoots of Ailanthus glandulosus, Desf., a description of which may be of interest to botanists. They grew in a lot near one of the university buildings during the summer of 1883. They sprang from small stumps, and are entirely the growth of one season. They give the following measurements: —

No. 1. — Length, 10 feet 6 inches; circumference at base, 5.1 inches; circumference at middle, 4.13 inches.

No. 2. — Length, 11 feet 1.5 inches; circumference at base, 4.1 inches; circumference at middle, 3 inches.

J. I. D. HINDS.

Lebanon, Tenn.

GOUVERNEUR KEMBLE WARREN.

IN the death of Gen. Gouverneur Kemble Warren of the Corps of engineers, U.S. Army, the country has lost not only one of the ablest military leaders developed by the civil war, but also a scientific man of high attainments, whose life was devoted to profound investigations connected with several of the most important works of internal improvement undertaken by the general government.

He was born on Jan. 8, 1830, at the little village of Cold Spring, upon the Hudson, where his surroundings were all calculated to excite a love for the military service in the mind of an active and intelligent boy. West Point lay in plain sight from his home. The old field-works of the revolution, grass grown and crumbling, were associated with his earliest recollections; and the charm thrown by Washington Irving over this classic ground of American history entered into and stimulated his youthful imagination to ideas above the prosaic monotony of every-day life in the nineteenth century. The Mexican war added fuel to the flame; and at the early age of sixteen he sought and obtained an appointment as cadet at the Military academy. He was graduated in 1850 with very high class rank, and was at once assigned to the corps of topographical engineers.

The great problem then beginning to attract attention was the Pacific railroad. The recent discovery of gold in California, and the consequent rush of immigration to the west, demanded increased facilities for transit across the continent; but a broad belt of wilderness, intersected by lofty ranges of mountains, and almost unknown, barred the way. It was in this field that the young officer did his first important scientific work.

Congress made large appropriations for exploring several routes between the Mississippi River and the Pacific Ocean; and the work, under the direction of Gen. (then Capt.) Humphreys, was performed by officers of U.S. engineers. As usual in such cases, the results were expected at once; and Lieut. Warren, who had already shown his ability on the surveys of the Mississippi delta, was detailed as principal assistant in the general office at Washington.

His duties were twofold. He assisted Capt. Humphreys, then laboring under great pressure, in digesting the preliminary reports, in investigating the various problems connected with railroad transportation, in making the comparative estimates of cost, and in preparing