searched for possible causes of their unhealthy condition. The trees in the best condition to examine were those on which the leaves were yet green, but from their general appearance indicated that they had been attacked by the characteristic trouble which was shown in a few yellow leaves at the tops. The roots of such trees were found in a perfectly healthy condition for some distance beneath the surface; the bark on the trunks from a distance of from five to fifteen feet from the base was green, full of sap, and apparently healthy; the leaves were almost free from insect attack and disease, in no case was there sufficient attack of this nature to indicate even a slight injury; the bark, however, at a point about two-thirds up from the base of the tree, was found in every case to be infested by *Dendroctonus frontalis* in sufficient numbers to kill all the bark for some distance above that point, and in this bark fully-developed beetles and pupæ were found on May 5, thus indicating that the eggs must have been deposited in the bark the previous summer or fall. All of the characteristic dead and dying Pine and Spruce trees examined showed abundant evidence that they had been invaded while yet green by this bark beetle.

It would seem that the turpentine escaping into the burrows made by the beetles in the green bark would render the conditions unfavorable for the progress of their work. They have, however, the power of removing it from their burrows, and they manipulate the sticky resinous substance with seemingly as much ease and in a like manner as the crawfish does the clay it piles up around its burrow. Often a half teaspoonful of the turpentine will be found massed about the entrance to the burrows made by the beetle. They push the turpentine out through a hole kept open in the pitchy, adhesive mass. I have observed them backing out from the entrance, shoving behind them a quantity of the turpentine, and at the same time they would be completely enveloped in it.

Trees invaded by these beetles the previous fall may remain green until spring when they are usually attacked by the large *Dendroctonus terebrans*, *Hylurgops glabratus*, and *Tomicus calligraphus*, the two former at the base of the tree, the latter in the green bark above. They are in turn followed by numerous other species of bark and timber beetles until the invaded trees may be, as I have found, the hosts of at least twenty-five species of scolytids coming like reinforcements to the aid of *D. frontalis* to make doubly sure the death of the invaded trees. Later on, these scolytids are followed by insects belonging to other families until a dead or dying tree may be the host of hundreds of species and millions of examples, breeding in and feeding upon every part of the tree from the base to the terminal twigs, rendering it worthless for lumber within a year after it dies.

Thus it will be seen that *Dendroctonus frontalis* may be the primary cause of not only the death of the trees but of their rapid decay.

West Va. Agricultural Experiment Station, Morgantown, West Va., July 20.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Auroral Display.

ON Saturday evening, July 16, there was visible, from this locality, in the northern heavens, the most brilliant auroral display which I have witnessed since the year 1859. Besides the usual exhibition of streamers of various hues, dancing along the northern arch like great hanging curtains, there was one most unique feature which I never saw or heard of before. A little after 10 o'clock, when the great brilliance of red and pink streams seemed to be dying out, and the northern heavens assuming a pale uniform hue, there appeared directly overhead a well-defined, nebulous arch, spanning the entire vault of heaven from east to west. At first a companion suggested that it was the Milky Way; but a few seconds' observation detected the Milky Way, running nearly at right angles with the arch — the two resembling each other somewhat in width and general appearance, except that the arch was more clearly defined and uniform in shape and outline than the other. In about fifteen minutes it began to fade away and disappear, the eastern portion disappearing first. In a short time there was only a bright strip near the western horizon, which much resembled the tail of a comet; but it, too, soon disappeared, and there were then no traces of the arch to be seen.

However, in a few minutes it began to reappear, and soon shone out bright and clear as before, — the arch being five to six degrees in width, — the eastern extremity at the horizon being a little south of east, and the other extremity being a little north of west, as if the whole had been drawn by a radius of a circle whose centre was a little east of the north pole. In ten or fifteen minutes this arch also disappeared as before.

Between the arch and the upper extremities of the gay streamers in the north there were several degrees of space lighted up by stars, and without any apparent connection between them. The band or arch seemed wider at the zenith than on either horizon — probably the effect of the greater distance of the horizon points from the position of the observer. The night air was quite cool, and I retired before midnight; and I have not learned whether or not the arch again reappeared.

T. A. BEREMAN.

Mount Pleasant, Ia., July 20.

Magnetic Storm, Aurora, and Sun-Spots.

A MAGNETIC storm raged here from 10.30 A.M to 4.30 P.M., central time, on Saturday, July 16, 1892. An electro-magnetic wave reached the general telegraph office of the C. B. & Q. R. R. at 10.30 A.M., making it difficult to operate, especially with the quadruplex. The duration of the electric disturbance was six hours; but the impulses came with varying intensity. The energy always appeared as a wave, beat, or oscillation; and when fully developed in the wires, seemed to set up a counter electro-motive force in opposition to the batteries. The fact that electro-magnetic energy traverses space in the form of waves, coincides with the now classical experiments of Hertz, who projected these waves not only through space, but brick walls. Perhaps a law like this will be discovered — *All modes of energy alternate.*

It is doubtful if a constant pressure exists in nature. In some instances, telegrams have been sent by means of nature's electricity — without batteries. This is merely a prophecy of that time coming when men will appropriate electricity when they want it, as they do light and heat.

An aurora appeared at 9.40 P.M., and consisted of many pearl-colored columns, at times tinged with red, occupying more than 100° in azimuth, and all converging near Polaris.

At 9.45 an apparition unusual in auroral displays was seen. This was a streamer of nearly white light, that, starting in a sharp point almost on the horizon, in the north-west, shot with great velocity north of Arcturus, passed over Corona Borealis, which constellation it equalled in diameter, crossed Hercules and Cerberus, and, passing over Altair, descended almost to Mars in the south-east, terminating also in a fine point.

This majestic sword moved bodily 10° to the south, and, after shivering and pulsating throughout its length three times, vanished, after existing fourteen minutes. The whole aurora lasted forty minutes. On July 9, a large cluster of spots, with two smaller groups and one larger isolated spot, were seen on the sun. All the larger spots had bridges, and on the 12th and 13th the tongues across the large one began to curve, which curvature rapidly increased on the 14th and 15th. On the 16th, these jets were arranged nearly in a circle, or had assumed

the twisting, rotary, or cyclonic form. One of the tongues was brighter than the solar surface, and seemed to be the most brilliant at from 9.30 to 10.30 A.M., at which time the electric wave disturbed the telegraphs. Whether the solar turbulence causes terrestrial magnetic upheavals is a question that future physicists must decide.

A sun-spot maximum is drawing near, and already there are lively electro-magnetic times. EDGAR L. LARKIN.

Knox College Observatory, July 19.

The Crinoid Heterocrinus Subcrassus.

TWO or three years since, I concluded to find out, if I could, the character of the termination of the column of the crinoid Heterocrinus subcrassus. Having a lower silurian slab with about one hundred specimens of the calyx, with a great profusion of the columns diverging in every direction, I selected a column attached to its calyx, and followed it by uncovering, until I was rewarded by discovering the column diverging into well-defined roots; length of column from calyx 12½ inches, about 1¼ inches under the surface.

At that time I believed that the genus Glyptocrinus were floaters, and devoid of bases, or roots.

About eighteen months ago something caused me to doubt that idea, and I commenced the investigation of the terminations of their columns, and now, after a great deal of work, and after many discouragements, I have been able to so far develop roots on the terminations of the columns of Glyptocrinus neali, Glypt. dyeri, and Glypt. baeri, that I have a specimen of each species, showing the calyx, column, and roots intact, on the slab, one slab of Glypt. baeri having on its surface several specimens of that character.

One character of the specimens surprised me,—the diversity of the length of the columns between calyx and roots in the specimens just mentioned, the column of Glypt. neali, from two to four or five inches; Glypt baeri, from one-half an inch to six or eight; Glypt dyeri, from one to four or five inches between calyx and roots.

I have also found a specimen of Heterocrinus simplex, showing calyx, column, and inverted saucer-like base, attached to another column. DR. D. T. D. DYCHE.

Lebanon, O.

Professor Parker's Further Studies on the Apteryx

IN No. 435 of *Science* the writer invited attention to the very valuable contributions to our knowledge of the morphology of Apteryx that had been made by Professor T. J. Parker, F.R.S., of the Otago Museum (New Zealand). Those investigations have been continued on more extensive material, and the London Royal Society have just published in their Transactions (1892) the results, in a paper entitled "Additional Observation on the Development of Apteryx" (11 pages; two col. lith. plates, of 19 figs.). Professor Parker has kindly sent me a copy of this work, and I desire to say, in the present connection, in continuation of what already has been noted by me in my former review, that more advanced embryos of the bird under investigation (stage F[1]) show "the pollex is unusually large, and the fore-limb has the characters of the wing of a typical bird." Better figures are given than in the first paper, showing structures of the brain and skull, and also that one "specimen exhibits an unusual mode of termination of the notochord." In other figures (stage G') the final form of the chondrocranium, before the appearance of cartilage bones, is shown, and, what is a very interesting fact, "that in *A. oweni* there is always a solid coracoid region to the shoulder-girdle, while in *A. australis*, as far back as stage F', there is a coracoid fenestra and a ligamentous procoracoid." Finally, it is worthy of note that "in addition to the elements described in the corpus an intermedium may be present" As I have already said, the working out of these anatomical characters, in such an important form as Apteryx, will most certainly prove to be of the highest importance and use to the general comparative anatomist the world over. There could be no safer hand to accomplish it for us than that of the distinguished biologist of the Otago Museum. R. W. SHUFELDT.

Takoma, D.C., July 24.

A Satellite of the Moon

I HAVE seen accounts of an attempt to discover whether the moon has a satellite, and the accounts that have reached me seem to show one serious fault in the procedure. While I am not thoroughly conversant with all the points involved, it does seem to me, that, in taking a photograph of the region in which such a satellite would be found if it exists, the apparatus should be arranged with reference to stellar motion, and leave the moon out of question. Of course, the moon would be blurred, but we are not concerned about that. The fixed stars would appear plainly on the plate, while any one that had a motion different from theirs, especially a rapid motion such as a satellite of the moon must have, would appear blurred on the plate; in which case only the blurred stars, if such occurred, need be examined with any hope of finding a satellite of the moon. C. P. MAXWELL.

Dublin, Tex., July 20.

Auroral Display.

ON Saturday night, July 16, 1892, I was returning to my home in Rockville, Indiana, from Clinton, Indiana, sixteen miles south-west. Mr. Harry McIntosh, a young man of this place who had been helping me make a survey near Clinton, was riding with me in my buggy. We amused ourselves looking at a most beautiful sunset as we rode over the Lafayette and Terre Haute road, along the foot of the high hills east of the Wabash River.

When we turned eastward, over the hills toward Rockville, it began to grow dark, and most of the clouds that showed up so beautiful at sunset began to vanish, till only a few streaks of stratus clouds remained. As we were descending the west hill at Iron Creek, five miles south-west of Rockville, we saw in front of us what we supposed was the new electric light at Rockville, thrown upward and reflected from a cloud or mist. As we were ascending the hill on the east side of the creek and near its summit, we saw in our front the reflection of a great light from behind us. It was so noticeable as to cause us both to turn about on our buggy seat and look backward. There, at a bearing S. 60° W. (that is the bearing of the road, with which the light was in alinement), we saw a great white light radiating from a point at the horizon where it was brightest, right, left, and upward to a height of 10° to 15°, weakening in brilliancy as it radiated and terminated in a dark band or segment of rainbow shape, some 10° wide. The light seemed to radiate from a point a half-radius above the centre of the circle which the black segment would indicate. Above the dark segment another segment or band of light, not so bright as the one at the horizon, formed a rainbow, or arch, some 10° to 15° wide. Above that second band of light was a light haze, or mist, through which the stars could be easily distinguished. Some 10° up in that mist, and directly over the centre of the light at the horizon, was a light about as large as a man would appear to be if suspended from a balloon a thousand feet distant. It was about four times as long vertically as wide horizontally. Young McIntosh saw it first and called my attention to it, as I was watching the bright light at the horizon. When I first caught sight of it, it had the appearance of the head of a comet, only it was long vertically. When young McIntosh first saw it, it seemed to be a blaze such as a large meteor appears to carry at its front. We halted and watched it about ten minutes, during which time it (the small light) slowly faded till only its locality could barely be noticed, then suddenly loomed bright almost to a white blaze, then slowly faded as before. It would loom up in five seconds, and consume five minutes in fading away. It kept the same position all the time, for we watched its position with relation to the stars to see if it moved. At this second appearance I decided to commit the general appearance to memory so I could sketch it afterward This little light loomed up and faded four times when the big light under it faded also and made it dark there.

I am not sure we saw this light the first time it appeared, but think we did. The small light above looked as the moon does when shining through a thin cloud, except as to the oblong shape vertically.

When the first or south-western light faded nearly out, a light