one to ten times as great. Many of them have a diameter of less than one fifty-thousandth of an inch and it is probable that there are multitudes of them so small that the highest powers of the microscope do not render them visible. Two thousand of them could swim side by side through the eye of a needle and one could hold in his single hand fifty millions of millions of them. Of the smaller ones it would take 15,625,000,000,000 to fill one cubic inch.

Now compare these with our mammoth Sequoias. The trunk of one of these trees, to say nothing about its roots and branches, contains at least 200,000,000 cubic inches. It is, therefore, 3,125,000,000,000,000,000,000 times as large as a single bacterium. This number is, of course, inconceivable. It may be read 3 125 millions of millions of millions. The proportion is about the same as that of an ordinary football to the earth itself.

Again, the duration of the life of many of the bacteria is only an hour. There are 8,760 hours in a year, and in 3,000 years there are 26,280,000 hours. Thus the tree has lived on while more than twenty-six millions of generations of its invisible kindred may have lived and died in the stream at its base. From the bacterium to the sequoia, what a span! Yet the rolling globe on which they live is but a speck in the universe, its diameter too small to be used as a measuring unit for interstellar spaces. As many bacteria could be laid side by side on a linear inch as earths upon the diameter of its orbit around the sun. Compared with the tree, the bacterium is almost infinitessimal; by the side of the earth, the tree is insignificant; in the solar system, the earth is but a small factor; and if the solar system were annihilated, it would be millions of years before its loss would be felt on distant stars. Magnitudes are, therefore, relative, and things are great or small according to the standpoint from which we view them.

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DESTRUCTION OF CROWS DURING THE RECENT COLD SPELL.

BY DR. ROBERT RIDGWAY, SMITHSONIAN INSTITUTION, WASHINGTON, D.C.

WHETHER it be the result of disease or exposure, the suffering inflicted on the crows in the vicinity of Washington during the recent severe weather is of great extent, and of such a character as to excite the sympathy of any one familiar with the facts. On the 20th of January my son went rabbit hunting, and on his return told me he had found many dead crows in the pine woods, and others that were totally blind. The following day I accompanied him to the place where he had found them, and was really astonished at the sight presented. Very few crows were seen flying about, but upon entering the thick woods of scrub-pines, which was evidently the roosting-place of large numbers of these birds, they were met with on every hand. Some were lying on the snow, dead and frozen stiff; many more were perched in the trees, at various heights, in all stages of helplessness. The majority of them could fly, and on our near approach would do so; but in a moment it became apparent that they could not see, for the first thing in their line of flight, as, for example, a branch, would stop them, when they would either flutter to the ground or, changing their course, would continue their flight, to be again checked by a branch, or if they happened to miss any obstruction until clear of the woods (which rarely occurred) they continued, slowly feeling their way, over the open fields, often dropping to the snow-covered ground after flying a few hundred yards. Those which did not fly at our approach were too much weakened from starvation to do so. They were easily caught, and in every instance were found to be absolutely blind, except one individual, which had one eye but little affected. In many the eyes were closed and much swollen; in some one or both eyes had burst and frozen, this having possibly been caused by violent contact with the sharp ends of broken twigs. In all cases in which the eyes were not closed or inflamed the pupil was milky white and the iris bluish. Inability to find food on account of their blindness was evidently the immediate cause of starvation; for it was found that the dead birds were, as a rule, very much emaciated, while many of the living ones, particularly those which were most active, and consequently difficult to capture, were in fairly good condition. It was pitiful to behold their suffering, both from the pangs of hunger as well as from the pain of their wounded eyes. Sometimes the snow beneath the trees was nearly covered by pine needles and small twigs which they had plucked off and tried to eat (they were seen doing this), while several of those which had fallen to the ground were eating snow.

The extent to which this epidemic, or whatever it may be, has affected the crow population of this locality is not easy to estimate. My first impression was that the species was nearly exterminated there, since certainly 95 out of every 100 crows seen during the day were perfectly "stone-blind," and 10 per cent of them dead. That this impression was incorrect was, however, proven by the next day's observation, the locality being visited much later in the day, when large numbers were seen coming in from the surrounding country to roost, — all these "able-bodied" crows having been abroad after food at the time of our previous visit. There seemed to be about as many of these as there were of the disabled ones, so the reduction in their numbers will probably not exceed one-half, and may not be so great.

A third visit, several days later, showed no increase among the afflicted birds. There were, however, as might have been expected, a much larger number of dead ones, while those still living were found more scattered, being encountered nearly everywhere in the open fields, where they had fallen, exhausted, during their flight from the woods.

So far as I was able to discover, after very careful examination of all specimens within reach, during both visits, only the common species, *Corvus americanus*, was affected by the malady. At any rate, neither my companions nor myself could discover a single fish crow (*C. ossifragus*), though the latter was well represented among those which were flying about.

I am at a loss to account for this scourge. Several causes have been suggested, the most plausible of which, it seems to me, is that in returning to their roosting-place one excessively cold evening they were compelled to face a freezing wind, perhaps bearing minute ice-particles, which actually froze their eyes. It may be, however, that a better explanation can be given.

REMARKS ON AMERICAN LICHENOLOGY. — III.

BY W. W. CALKINS. CHICAGO, ILL.

THE explorers for lichens in a locality so favorable as Florida will not fail to notice the abundance of brilliantly colored fungi, and, if interested, will be tempted to collect them. On some of these will perhaps occur parasitic lichens of rarity, as *Colnogonium* and *Opegrapha*. But beneath a bed of *Agaraci*, on the sandy soil of an old plantation, a close search will show another interesting lichen, known as *Heppia despreauxii* Tuck. Its character was long disputed, owing to a close resemblance to an allied genus of lichens, *Solorina*. The small cup shaped apothecia, growing single or in clusters, immersed in a green thallus, have deceived good lichenists. We owe to Dr. Tuckerman the elucidation of this elegent species. Only two were described by him in the "Synopsis." Last winter I had the good fortune to find anotner in the mountains of Tennessee, which, having been sent in vain around our own country, a puzzle to all, was promptly determined by Dr. Nylander of Paris to be the *Heppia virescens*, *Ach. variety rugosa* Nyl. I may remark that it is astonishing how soon afterwards we all saw the point.

In the old field as well, with a mixed second growth of *Pinus taeda*, *Ilex opaca*, *Ilex Cassine*, *Myrica cerifera*, *Olea americana*, etc., will be found on their foliage numerous small fungi, such as *Sphaeria* and *Cercospora*, many of which have been illustrated by Professor Ellis in his "Exsiccati" from my collections of fungi.

In close contact, lichens and fresh-water algæ and *Hepaticæ* also hold equal sway. But, towering over all, the stately *Magnolia* and the *Gordonia* (red or bull bay), with their glossy evergreen foliage, afford us the tropical lichen, *Strigula complanata* Fee., and, rarer still, *Heterothecium augustini* Tuck., though, indeed, the *Sabal serrulata*, common everywhere, abounds in elegant specimens in

some localities. There are also on this prostrate palm most remarkable fungi, for which see Ellis. By the slow-running stream occur *Biatora hynophila*, on mossy substrates. Many terricoline lichens of rarity will reward a patient collector. I have often visited one locality, leaving it at last in the belief that nothing more could be found. However, still unsatisfied and impelled by something, I would return and find new prizes, as I soon learned from my teachers. I mention this to show that no researches in the field of nature can be wholly completed. I also offer it as an incentive to thorough work. Whilst lichens thrive almost everywhere in Florida, sometimes in very novel situations, the vicinity of the ocean is prolific of them. Even an old *Ostrea* shell has its peculiar *Verrucaria;* on old timber, *Xylographa;* while just inland, among dense thickets of *Ilex cassine*, revel *Arthonias* and *Graphis*. Here also the beautiful rosettes of the *Cladonia rangiferina* L., *variety alpestris* L. (which is *F. minor* of Michaux), cover the earth and are known to the uninitiated as mosses,—price to the winter tourist who searches for nature's gems in hotels twenty-five cents.

In open places the eye will often rest upon a carpet of the crimson-fruited *Cladonia leporina* Fr. and *C. pulchella* Schw. There are also other species of this genus, but less conspicuous on account of having brown fruit. On shrubs near the sea occur in abundance very fine specimens of *Ramalina rigida, variety montagnaei* Tuck. But we tire of conspicuous forms at last, and seeking the most difficult and least known, find them in *Arthonia* and *Graphis*. The following species are sufficient to show what may be expected in a field where investigations have been merely begun.

Arthonia albovirescens Nyl. A new species on *Ilex cassine* at Fort George, and on shrubs in tropical Florida. A good species (Nyl. Lich. N. G) (*Bot. Bull.*, 1889). (*Syn. Arthonia* Willey.) Abundant.

Arthonia floridana Willey. A new species collected by me at Jacksonville on *Ilex* (*Syn. Arthonia* Willey). Rare.

Arthonia ochrospila Nyl. On *Myrica cerifera*, at Jacksonville. Also Cuba. Rare.

Arthonia gregarina Willey. On *Myrica* sparingly at Jacksonville and south. (*Syn. Arth.*)

Arthonia taedescens Nyl. A very fine and rare species on *Ilex cassine*, at Jacksonville and south. (*Syn. Arth.*)

Arthonia ochrodiscodes Nyl. A new species, *Ilicicola*. Fort George and southward. Described by Nylander in "Lichenes Japoniæ," page 107. Quite distinct. Abundant.

Arthonia platygraphidea Nyl. An elegant species I collected from Fort George south. Also Mexico.

Graphis adscribens Nyl (*Lich. N. Caled.*). Found by me on *Gordonia* and other trees, Jacksonville to tropical latitudes. Also in Mexico. Very fine.

Graphis nitidescens Nyl. Very minute, white, and hard to find. I have had several so named, all differing from the true one identified for me by Nylander. On *Liriodendron*, at Jacksonville and southward to Cape Sable (Tuckerman, Syn. Pt. II., page 123).

Among the new *Graphis* of Florida described by Nylander, I will only mention now *Gr. abaphoides, Gr. subparilis, Gr. subvirginalis, Gr. turbulenta*, all tropical or sub-tropical.

Platygrapha subattingens Nyl. A new species, *Supercorticem, Liriodendri*, at Jacksonville; southwards to Cuba. Described by Nylander in "Lichens N. G.," page 51. A very fine lichen (*Bot. Bull.*, 1889).

OSTEOLOGICAL NOTES.

BY DANIEL DENISON SLADE, MUSEUM OF COMPARATIVE ZOÖLOGY, CAMBRIDGE, MASS.

THE order of the Ungulata may at the present time be divided into the Ungulata vera, including therein the two sub-orders, Perissodactyla and Artiodactyla, and the Ungulata polydactyla, or Subungulata of Cope, which also comprises two sub-orders, Hyracoidea and Proboscidea.

In its morphology, the jugal arch of the Ungulata presents various modifications. With few exceptions, two bones only enter into its composition, the squamosal and jugal, which are connected by a suture, the general direction of which is horizontal. Both the horizontal and vertical curvatures of the arch present considerable variations, as does also its relation to the neighboring parts.

In the group Perissodactyla, the family Equidæ exhibits an arch, which, although relatively slender, is quite exceptional in its arrangement. The large and lengthened process of the squamosal not only joins the greatly developed post-orbital process of the frontal, but, passing beyond, forms a portion of the inferior and posterior boundary of the orbit. The malar, spreading largely upon the cheek, sends back a nearly horizontal process to join the under surface of the squamosal process above described, thus completing the arch, while the orbit is entirely surrounded by a conspicuous ring of bone, thereby clearly determining the bounds between it and the temporal fossa, which last is remarkably small. Moulded into this fossa, which is bounded above and posteriorly by more or less well-developed crests or ridges, is the temporal muscle. The pterygoids are slender and delicate, without the presence of any fossa. The glenoid surface is much extended transversely, concave from side to side, and bounded posteriorly by a prominent post-glenoid process. The angle of the jaw is much expanded. The condyle is much elevated above the molar series, while the coronoid process is long, narrow, and slightly recurved.

In the Rhinoceridæ and Tapiridæ the arch is strongly developed, and composed of the squamosal and jugal processes, which are joined at about its centre by an oblique suture from above downwards, backwards, and upwards. There is a small post-orbital process, largest in the tapir, but the orbital and temporal fossæ are continuous. The surface for the temporal muscle is extensive. The glenoid fossa presents a transverse, convex surface to articulate with the corresponding one of the mandible, which is not much elevated above the dental series. The coronoid process is slender and recurved, while the angle is broad, compressed, somewhat rounded, and incurved.

In the Artiodactyla, the arch is slender, and is composed of the process from the jugal, which passes backwards beneath the corresponding forward projecting process of the squamosal, the juncture being by a suture nearly horizontal in direction, and longest in the Cervidæ. The jugal also sends up a postorbital process to meet the corresponding descending one of the frontal, the suture which unites them, being about midway. Thus the bony orbit is complete, while the jugal is forked posteriorly. The temporal region is relatively small. The horizontal curvature of the arch is very slight. The glenoid fossa is extensive and slightly convex, with a well-developed post-glenoid process. The pterygoids present a large surface and are situated nearer the middle line than is the case in the Perissodactyla. The condyle is broad and flat, and the coronoid process is long, compressed, and slightly recurved. The angle is rounded and much expanded.

The Tylopoda alone among the Ruminantia have large surfaces and accompanying crests and ridges for the increased development of the temporal muscles. The horizontal curvature of the arch is greater than in the true Ruminants, consequently the temporal fossa is wider and deeper — all in correlation with the powerful canine teeth. The forked articulation between the molar and the squamosal is also more strongly marked.

Among the non-Ruminantia, the family Suidæ, or true pigs, exhibit an arch in which the process of the jugal underlying the squamosal extends back to the glenoid fossa — the two bones being connected by a suture, which is vertical anteriorly for the depth of half the bone, and then horizontal. The post-orbital process does not meet the frontal; in fact, all traces of this are lost in Sus serofa. In the Peccary and Barbaroussa it is quite prominent. The arch is short, and the vertical as well as horizontal curvatures are considerable. The narrow, transverse, condylar surface of the mandible, and the small coronoid process, with its rounded superior surface, are but slightly raised above the level of the alveolar surface. The pterygoid surface is extensive and the fossa deep.

In the Hippopotamidæ, the arch is broad and strong. Its superior border presents a marked sigmoid curvature, and the con-