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 convexity, which is always posterior, is in this case much shorter in proportion. The temporal fossa, as also the surface for the muscular insertions, are extensive. The pterygoid surface is not so large as in the Suidæ. The glenoid fossa is slightly concave, but not bounded externally by a continuation of the jugal. The condyles of the mandible are nearly on a level with the molars, and the coronoid process is small and recurved. The angle is greatly modified for muscular attachment.

In the Hyracoidea, the arch is composed of three bones, of which the jugal is the most important. Resting anteriorly upon the maxilla, the jugal sends backwards a process to form the external boundary of the glenoid fossa. It also sends upwards a post-orbital process to meet a corresponding one from the parietal alone or from the parietal and frontal combined, thus completing the bony orbit. Both horizontal and vertical curvatures are slight. The surface for the temporal muscle is largely developed, while the pterygoid fossæ are well marked. The ascending ramus of the mandible is high, and the angle is rounded and projects very much behind the condyle, which last is wide transversely, and rounded on its external border. The coronoid process is small, slightly recurved, and not on a level with the condylar surface.

In the Proboscidea, the arch is straight and slender and composed of three bones. The maxilla forms the interior portion, while the jugal, supported upon the process of the maxilla, meets that of the squamosal in the middle of the arch, and is continued under this as far as the posterior root. This modification is unlike that of any other ungulate. There is a small post-orbital process from the frontal. The temporal surface is extensive, and that of the pterygoid considerable. The ascending ramus of the mandible is high, and the condyle small and round. The coronoid process is compressed, and but little elevated above the molar series. The angle is thickened and rounded posteriorly.

As has previously been remarked in regard to other orders of the Mammalia, the modifications undergone by the jugal arch in the Ungulata are determined by the development of the masticatory muscles. In the Perissodactyla, for example, the sagittal crest, ridges, and extensive parietal surface are correlated with increased insertions of the temporal muscle, while the large, strong, and complicated arch have equal reference to a powerful masseter. So in the Artiodactyla, especially in the Ruminantia, the diminished surface for the temporal, and the smaller, weaker arch, both denote diminished energy in the above muscles, while the enlarged pterygoid muscular insertions show that the required action has been provided in another direction. As Professor Cope has shown, "Forms which move the lower jaw transversely have the temporal muscles inversely as the extent of the lateral excursions of the jaw. Hence these muscles have a diminished size in such forms as the Ruminants, and are widely separated."

The singular fact that the Tylopoda alone of the selenodont Artiodactyla possess the sagittal crest is explained by Professor Cope, by the presence of canine teeth, which are used as weapons of offence and defence, and which demand large development of the temporal muscles. Moreover, this group retains the primitive form of the molar series, which is below and posterior to the vertical line of the orbit, while in the Bovidæ it is anterior.

EARLY METHODS OF BORING.

BY JOSEPH D. MCGUIRE, SMITHSONIAN INSTITUTION, WASHINGTON, D. C.

IN the process of recent investigations at the National Museum into early methods of boring as practised by different races, the writer thought that the similarity existing between the Esquimaux toggle or two-handed strap-drill, and practically the same implement used by the ancient Greeks and Hindus, and also the resemblance between the bow-drill used by the early Egyptians and the same tool used by American Indians could not fail to interest those concerned in early methods of boring.

There is an Egyptian fresco in the Royal Museum of Berlin representing a workman with a bow-drill boring a hole in the bottom of a chair, and the only difference between the drill he is using and those in the National Museum collection, especially from the Eskimo in area, is that the Egyptian bow appears much longer than the same tool used by our Indians.[1]

There is much in a comparison of these drills that is of interest regarding the evolution of the implement and the possibility of independent invention. The toggle or two-handed drill consists of a shaft a foot or more in length, a head-piece or bearing of wood or ivory, with often a stone socket for the drill-shaft to revolve in at the top. This socket-piece is held by the one working it between his teeth, and thus kept in position. The shaft is revolved by means of a narrow strap of leather wrapped once around it. On the ends of the thong are tied pieces of wood or bone by which the operator pulls the strap alternately to the right and to the left, thereby revolving the drill, which by downward pressure on the socket-piece is prevented from slipping aside.

In the ninth book of the Odessey, Ulysses describes how he and his companions, imprisoned in a cave, bored out the eye of Polyphemus (Cowper's translation.)

"They grasping the sharp stake of olive wood,
Infixed it in his eye, myself advanced
To a superior stand, twirled it about.
As a shipwright with his wimble bores
Tough oaken timber, placed on either side
Below, his fellow artists strain the thong
Alternate, and the restless iron spins,
So, grasping hard the fire-pointed stake,
We twirl'd it in his eye; the bubbling blood
Boil'd round about the brand."

The bow-drill used by the Zuni and other American tribes is an immense improvement on the above, for the thong is attached to a bow worked with the right hand, and the head-piece is held by the left, thus saving the jar to the head and teeth, which with the toggle drill was considerable.

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.

Confusion in Weights and Measures.

THE remarks of Professor W. P. Mason on "Confusion in Weights and Measures" in *Science* for Dec. 23, 1892, are interesting and timely. A few erroneous statements which they contain serve only to emphasize the fact that the system of weights and measures in customary use is so confusing, so unscientific, and, in some instances, apparently so contradictory that it is difficult to write of it, even briefly, without falling into error. It may be useful to the readers of *Science* to have some of these errors corrected and also to be furnished with a brief statement of the existing condition of the question of standards in the United States.

Professor Mason's difficulty in ascertaining the number of grains in a gallon of water at 60° F. is a very natural one, and one not likely to disappear in the near future. The United States gallon is a measure of capacity and not of mass. It contains 231 cubic inches. The mass of this volume of water at any given temperature can only be determined by experiment, and an accurate determination is exceedingly difficult. All results must be regarded as approximations, and variation among them means no more than variation among published values of other physical constants, which are determined by experiment, but can never be fixed by legislation. It has always been customary in the United States Office of Weights and Measures, as indeed it may be regarded as almost necessary, to adjust the volume of a capacity standard by ascertaining the mass of water which it will hold under certain conditions of temperature and pressure. But this is merely a matter of convenience; the gallon is by definition 231 cubic inches, and the bushel is 2150.42 cubic inches, and when it is desired to ascertain the mass of a gallon of water one must select that value of the density of water which one thinks the

[1] Lepsius, Kong'l. Museum, Abtheil. der Aegypt. Alterthümer, Berlin, 1855, tafel x.