vexity, 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 Eskimoan 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.

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

## 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