Nebr. The skeletal parts known at present are the skull and mandible; the vertebral series, complete as far as exposed, and articulated; the pelvis and sacrum and the hind limbs complete and likewise articulated; several ribs attached to the vertebræ above and to the sternum below, and a portion of one scapula. The fore limbs are not yet in evidence, but will doubtless be found either in the material collected or else in the quarry, which still showed numerous bones when work was suspended.

The most striking characteristic of the skull is the four prominent horns, of which the frontal pair rises upward and curves inward, while the maxillary pair curves in the opposite direction. The maxillary horns, uniting as they do at the base to form a common trunk, divide the anterior nares into two portions, the posterior of which may or may not have been functional. However this may have been, the margin of the opening seems to have been roughened as though for ligamentous attachment. The dentition is complete, though, consequent to age, the teeth are worn. The premaxillæ are edentulous. The upper canines, which are strong and defensive, curve noticeably outward. The lower canines have migrated and assumed an incisiform function, while the first premolars have in a like manner become caniniform. Dentition:

$$\text{I. } \tfrac{0}{3},\quad \text{C. } \tfrac{1}{1},\quad \text{P. } \tfrac{3}{4},\quad \text{M. } \tfrac{3}{3}.$$

Measurements of the skull: Length of skull, 12¾ inches (325 mm.); distance between the orbits across the frontals, 5 inches (128 mm.); height of anterior horn cores above plane of molars 6½ inches (166 mm.); spread of same at summits 8¼ inches (210 mm.); height of posterior horn cores above plane of molars 7¾ inches (197 mm.); spread of same at widest point 10 inches (254 mm.); width of palate between molars 1¼ inches (32 mm.).

No attempt should be made at this juncture to fully define the genus. As to its affinities, *Syndyoceras* seems to be remotely related on the one hand to *Protoceras* of the Oligocene, and on the other hand to the modern antelopes. *Syndyoceras* may be placed for the present with the Protoceratidæ, but it is doubtless entitled to a place in a new family.

ERWIN HINCKLEY BARBOUR.
THE UNIVERSITY OF NEBRASKA, LINCOLN,
October 1, 1905.

NOTE ON THE FUNCTIONS OF THE FINS OF FISHES.

THE exact determination of the function of each kind of fin in fishes does not appear to have been treated in a practical manner up to the present time, and these organs are in general regarded as of little importance for swimming. It occurred to me that a few experiments might elucidate the question. Unfortunately, I had and can have, at my disposal, only fishes with fins but little developed and in small number, so that the facts which I am going to set forth have only a relative bearing, and only naturalists having sufficient material at their disposal will be able to establish general rules.

I had in the aquarium of the state college three or four small specimens of *Goodea atripennis* (a cyprinodont) four or five centimeters long, taken in a pond in the state of Guanajuato. One of these individuals attracted my attention by the entire absence of its dorsal fin; whether it had disappeared by accident or whether it had never existed was not evident. Since the creature swam exactly like those which were perfect, I thought of investigating the function of this fin and also of the others, both paired and single.

No. 1. Individual without dorsal fin. My preparator cut off the anal fin close to the body. No difference whatever was observed in the creature's movements. I conclude that, in *Goodea* at least, this organ exerts no influence in swimming or on the equilibrium.

No. 2. I took another fish and had the pectorals and the ventrals amputated, that is to say, the four members. At first the creature appeared somewhat astonished and hesitating; but at the end of an hour it finished by moving deliberately and swimming as usual. The pairs of fins appear, therefore, to have very little if any bearing on locomotion.

No. 3. A third *Goodea* served for the study of the caudal fin. That alone was cut off.

The fish remained at the bottom of the aquarium and went slowly to take refuge under a tile which served as a shelter. It was then three o'clock in the afternoon. The next day at the same hour I found it in a package of *Jussieua* plants which was floating on the surface of the water.

In order to examine my fishes closely, I removed the plants and observed that Nos. 1 and 2 did not appear to be at all influenced by the operation which they had undergone. Only No. 2, deprived of its pectoral and ventral fins, seemed unable to move easily. No. 3 moved the posterior portion of its body quickly, and by uninterrupted lateral shakes was able to turn, rise, fall and swim forward, but with much less rapidity and ease than the others, which, with a stroke of the tail, darted like arrows without needing to strike the liquid again in order to advance. The third fish ended by learning to replace his caudal by the movements of the dorsal and anal, which increased a little in size, doubtless from the exercise.

One more experiment remained to determine the functions of the fins and of the air-bladder. All the fins except the caudal were cut off of one fish. The creature thus mutilated at first appeared undecided, like No. 3, and moved slowly at the bottom of the aquarium; but the next day I saw him swim rapidly and execute with agility all his usual evolutions. The only noticeable peculiarity was that in order to keep himself in position he caused his only fin to vibrate rapidly and constantly, and that these vibrations communicated a trembling to the entire body. The equilibrium was, therefore, still preserved, and the air-bladder did not cause the fish to turn belly upwards, although he maintained himself at the bottom of the water, in the middle or at the surface, experiencing in consequence a series of different pressures. My friend, the learned Belgian professor, F. Plateau, so well known by his experiments on insects, and who encouraged me to publish these studies, writes to me that he teaches his pupils that locomotion in most fishes is effected by flexions of the entire caudal portion of the body, and that the undulations of the odd fins (dorsal, anal and caudal) serve only to give more precision to the general movements of locomotion; and that, save in exceptional cases, the functions of the pairs of fins are almost inappreciable. I am happy to see my observations accord with the ideas of a savant whose name carries weight.

When my fishes swim slowly or remain motionless, the caudal fin executes very clean helicoid movements (skulling). This fin appears, therefore, to be, not indispensable, but extremely useful in swimming. Progression forward is due to the alternate flexions of the tail, that is to say, of the part of the body situated behind the anus, as everybody knows; but, according to the observation made on No. 3, it is evident that the fin which terminates it lends it a very powerful aid, for both rapidity and uniformity of motion. With regard to the function of the pectorals, I have remarked that when the fishes which possessed them remained stationary they, nevertheless, continued to move these fins rapidly, and that the latter appeared to be intended to produce currents in the water to renew the portions of this fluid which had already yielded their oxygen to the gills and remained charged with carbonic anhydride.

It is evident that these experiments on a single species and on so small a number of fishes are insufficient to determine in a general manner the rôle of each kind of fin, and I publish them only to instigate other more varied studies, particularly by means of fishes provided with well-developed fins. With regard to those vertebrates which possess only the caudal, it is known that the shape of their body, especially of the posterior portion, perfectly explains direct progression.

Before closing this article, I wish to call attention to a fact which perhaps has not yet been observed, or at least not published. The amputated dorsal fin and the two pectoral fins have grown out again to a great extent. It is probable that the mutilated fishes continued mechanically to make use of the stump which remained to them, doubtless with a small fragment of the fin, and that under that action the rest of the organ reproduced itself. What would seem to prove it is the fact that, as I have said in speaking of No. 3, the dorsal fin increased in size on account of the use he made of it to replace the amputated caudal fin.

A. DUGÈS.

GUANAJUATO, MEXICO,
April, 1905.

LABORATORY EXPERIMENTS WITH CS_2 TO DETERMINE THE LEAST AMOUNT OF GAS AND THE LEAST TIME REQUIRED TO KILL CERTAIN INSECT REPRESENTATIVES OF VARIOUS FAMILIES.[1]

WHILE a sufficiently large series of insects has not yet been worked upon to draw a definite conclusion upon the above point, the following paper is submitted as showing some interesting results incident to this work. Experiments were begun in California a few years ago, and continued for a time in Minnesota. Three hundred and eighty-six insects have been tested. Of this number some have not been included in the tables, where the record was not regarded as sufficiently complete.

The points which might be brought out by an exhaustive series of observations in this line are as follows: Least strength required with a minimum expenditure of time to kill (*a*) insects in general, (*b*) particular groups, safety to foliage being understood; effect of moisture upon results; effect of temperature upon results; expense of material for effective use upon a known number of plants, trees, insect colonies or stored products, what per cent., if any, succumbed after seeming recovery; beginning effects of gas upon (*a*) insects in general, (*b*) groups in particular; significance of occasional spasmodic movements of legs, wings, sometimes long after apparent death; corroboration of laboratory results with results from the field as far as possible; different results with different brands of CS_2; corroboration with previous published statements.

Method and Apparatus Described; Computation.—The necessary crudity of the apparatus and method described is evident, and must render the results in the case of insects of any size not even approximate. An insect as large as *Ectobia,* or *Apis mellifica,* for example, or the larva of the western peach-tree borer, or that of the Mediterranean flour moth, evidently displaces so much of the gaseous contents of a vial when introduced, as to render absurd the proportions of gas to atmosphere as given. Even in insects smaller than these there is undoubtedly an error due to displacement, yet the writer believes that the method described here comes as near demonstrating facts in this connection as possible, particularly in the case of very small insects, and it has certainly brought out interesting results, from which we may select what appears authentic.

A large number of homeopathic vials were secured, of the same size (homeopathic 2 gram vial No. 1,657 with patent lip), also pieces of flexible rubber piping of such a size as to fit tightly over these vials. Into one vial a drop of CS_2 was allowed to fall from a medicine dropper, and the mouth of this vial immediately placed against the mouth of another empty vial, the rubber tubing referred to serving to hold the two vials closely together, and preventing any egress of gas, or entrance or exit of atmosphere.

The average capacity of these vials was 8.7 c.c., and it was upon this basis that our calculations were made. The volume of gas coming from one drop of CS_2 equaled 4.35 c.c., and, therefore, filled half a vial.

It is evident, therefore, that the union of the first two bottles, made immediately, before the gas had an opportunity of driving out any of the atmosphere, caused a mixture of one part of gas to four of atmosphere; the second change, one to eight; the third, one to sixteen; the fourth, one to thirty-two, etc., or, interpreting it with reference to the liquid volume of CS_2 to the atmosphere, we find that the union of the first two bottles equaled one part of liquid CS_2 to 1,494 parts of atmosphere, or in round numbers, 1,500 parts of atmosphere; the second change, one part of liquid CS_2 to 2,988 parts of atmosphere, or in round num-

[1] Abstract of paper read before the Association of Economic Entomologists at Philadelphia at their last annual meeting.