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FOSSIL LIZARDS OF THE WEST INDIAN GENUS *ARISTELLIGER* (GEKKONIDAE)

BY MAX K. HECHT

INTRODUCTION

Before the zoogeographical and faunal interrelationships of the West Indies can be fully understood, it will be necessary to consider in some detail the taxonomic relationships and probable origin of the component genera and species. Towards this end a review of the living representatives of the gekkonid genus *Aristelliger* is being prepared. This gekkonid genus is unique in that remains of fossil and living species are available for study. The present contribution deals with the subfossil and fossil remains.

SOURCES AND NATURE OF MATERIAL

Recently, Dr. Ernest E. Williams brought to my attention undescribed subfossil and fossil West Indian reptiles, particularly in the American Museum of Natural History and the United States National Museum. Some of this material was collected by Dr. Harold E. Anthony in Jamaica in 1919–1920. Anthony collected chiefly living and fossil mammals but also obtained abundant fossil lizard remains. One of the best lizard deposits was found in Dairy Cave, near Dry Harbour (now known as Discovery Bay), in St. Ann Parish. Additional fossil material was found in Dairy Cave during the summer of 1950, by Dr. Ernest E. Williams, Dr. Karl F. Koopman, Mrs. Bessie M. Hecht, and the author. New deposits were discovered in Jamaica by the 1950 party in a cave near Portland Point in Clarendon Parish, which was known as the Lower Portland Cave. Additional lizard remains were found in museum collections from Hispaniola and Cuba. Miller (1922, 1926, 1929) has discussed the mammalian elements of the cave deposits at St. Michel

d'Atalaye, Hispaniola, and their relative age. All the gekkonid material found in the Jamaican and Hispaniolan collections have been referred to the genus *Aristelliger*. Some of the specimens from Jamaica clearly represent a new species. The Cuban remains bear similarities to *Tarentola americana* of Cuba, but with certain less distinct resemblances to *Aristelliger lar* of Hispaniola. Allocation of this material cannot be determined until further study is made of the osteological variation within and between certain gekkonid genera.

The material available for study is of such recent age that very little mineralization has taken place, most of the bones being brittle. The specimens of *Aristelliger* consist of vertebrae (axis, cervical, thoracic, and caudal), maxillaries, dentaries, frontals, and a single parietal. The remains of this genus are unique in that limb bones and pelvic girdles are missing. This is in contrast to the remains of other lizards in the same deposits, in which these elements are represented.

DESCRIPTION OF THE CAVES

Collections from four caves have been investigated in connection with the study of fossil and subfossil *Aristelliger*. Hence a brief description of the caves and faunas seems desirable.

Three caves were investigated successfully in Jamaica by the 1950 party. They are: the Wallingford Cave near Balaclava, St. Elizabeth Parish; Dairy Cave near Discovery Bay, St. Ann Parish; and the Lower Portland Cave near Portland Point, Clarendon Parish.

Probably the oldest lizard-bearing deposit is in the floor sediments of the Wallingford Cave. Although no gekkonids are known from this cave, remains of at least one giant, extinct species of the anguid genus *Celestus* occur abundantly. Two extinct bat species, *Tonatia saurophila* and *Natalus major* (Koopman and Williams, 1951), occur in the same deposits and show that these deposits are relatively old.

The Dairy Cave is interesting because three distinct layers have been recognized. The oldest, in which material was collected by Anthony, henceforth referred to as the lizard layer, has the remains of a giant gekkonid, *Aristelliger*, and at least one giant species of *Celestus*, which may be conspecific with the *Celestus* of Wallingford Cave. Two extinct species of bats also occur, *Tonatia saurophila* and *Brachyphylla pumila*. The 1950 expedition at-

tempted to rediscover this deposit but found the cave much altered. Anthony recorded "millions" of bones in this deposit. His samples of the lizard layer certainly corroborate his field record. During World War II the Jamaican government filled and leveled much of the floor of the main cave with crushed stalagmites and stalactites, and as a result the lizard layer was buried deeply.

The 1950 expedition nevertheless discovered a small area containing sediments interspersed with thin layers of limestone in the west side of the same cave. It appears to the collectors that this entire layering was due to periodic changes in the aridity of the cave. Here two collections were made that were poorer in quantity than the lizard layer and appeared to be more recent in age. The oldest or lower strata contained one bat genus and no reptile material. The upper deposit included several genera of bats, and associated with them two species of *Aristelliger*, the extinct giant, and the living dwarf, species. It is noteworthy that none of the bats in these two deposits represent extinct species.

The presence of deep, smooth chambers in the roof of the Dairy Cave indicates that the cave has been exposed to solution action by underlying, possibly oceanic water. There is no evidence that these chambers in the roof were formed by seepage or drip from above. This theory of solution action is further supported by the fact that the cave faces the sea and lies within one-half of a mile of it. There is no evidence of marine strata above the terrestrial deposits, thus indicating that the latter were formed after the last main oceanic retreat. In the sediments of the cave floor there are interspersed layers of dripstone, indicating the periods of changing aridity. Stalactites and stalagmites are also present in part of the cave, suggesting later periods of seepage.

In the third locality, the Lower Portland Cave, the only lizard remains are of *Celestus* and *Aristelliger*. This is a shallow deposit lying 18 to 20 inches below the floor surface. From the associated remains, to be reported elsewhere, it would appear that the Portland deposit is probably younger than the oldest Dairy Cave deposit and may be of the same age as, or older than, the upper or middle Dairy Cave deposit. The Portland Cave was also formed by wave action. It is close to and faces the sea. However, unlike Dairy Cave, there are no stalactites or stalagmites. Whether this is owing to the earlier origin of Dairy Cave or is an indication that the Portland area has been arid since the formation

of the cave cannot be determined at present. There is no question that the Portland area, one of the most arid on the island of Jamaica, is much drier at present than the Dairy Cave region.

The only cave in Hispaniola from which remains of *Aristelliger* were obtained is at St. Michel de l'Atalaye, Departement de l'Ouest, Republic of Haiti; it was called Deep Cave by Miller (1929). The deposits from which *Aristelliger* was obtained appear to be quite recent in age. Miller (1929) mentions no stratigraphic sequence in these caves, despite the fact that he reports that some cave deposits at this locality are 5 feet in depth. All the bats from Deep Cave belong to living species, and both *Rattus* and *Mus* are listed from this cave. The only associated extinct mammals are *Nesophontes*, *Brotomys*, and *Isolobodon*, and these are believed to have survived until post-Columbian times. The faunal analysis of the caves of Hispaniola has not been so critical as that of the caves of Jamaica.

ALLOCATION OF THE MATERIAL TO GENUS

This is the first fossil gekkonid material from the West Indies and only the fourth fossil of this family known. An outline is therefore given here of the observations leading to the conclusion that the material herein discussed belongs to the genus *Aristelliger*.

Among the assorted reptile remains found in Dairy Cave in Jamaica were amphicoelous vertebrae and frontals of a lizard. The presence of a canal (Mahendra, 1949), formed by the down-growth of the undivided frontal, and surrounding the olfactory stalks, proved the bone to be that of a gekkonid (Cope, "1898"; Hoffstetter, 1946). The vertebrae were identified as gekkonid because of their amphicoely, since this condition is confined, among lizards, to certain gekkonid genera (the Uroplatidae are here included in the Gekkonidae). *Sphaerodactylus*, *Gonatodes*, *Aristelliger*, *Tarentola*, and *Hemidactylus* are the only gekkonid genera living in the Greater Antilles today. The first two genera have procoelous vertebrae and are thus immediately excluded from consideration. The remaining genera, *Aristelliger*, *Tarentola*, and *Hemidactylus* must, however, be differentiated.

As in many other gekkonids, the dentary of *Aristelliger* bears a well-developed shelf and groove on its lingual surface. The depth and the degrees of development of both the shelf and the groove serve to distinguish the dentary from that of some species of *Tarentola*. *Hemidactylus* is similarly characterized by a well-

developed groove and shelf. However, the posterior border of the external surface of the dentary of both *Hemidactylus* and *Tarentola* forms sutures with the coronoid and angular that are unlike those in *Aristelliger*. If the associated dentaries and maxillae belong to the same form as the amphicoelous vertebrae do, then all the elements are *Aristelliger*. The dentary, maxilla, frontal, and vertebrae of these fossils show great similarities to those of the living members of the genus.

Of the three amphicoelous gekkonids in the Greater Antilles, neither *Hemidactylus* nor *Tarentola* occurs in Jamaica today. Of these two genera, one is certainly a recent importation in the West Indies. The available evidence indicates that *Hemidactylus* was introduced into the New World by commerce. None of the species of this genus found in the New World¹ is distinct from those of the old world.

Tarentola americana known today from Cuba is recognized as a species distinct from the Old World members of the genus (Love-ridge, 1947). There is still, however, the possibility that this form was also introduced from the Old World. While this appears improbable it may have occurred. Should this be so, the parental population has not yet been recognized. If *Tarentola* does represent a native form, its distribution is of a relict type, for its nearest relatives inhabit Africa and the Mediterranean region. Remains of a gekkonid, possibly ancestral or related to *Tarentola americana*, have been found in Pleistocene cave deposits near Daiquiri, Province of Oriente, Republic of Cuba; these will be the subject of a future study. Critical elements necessary for positive identification of this gekkonid genus are still missing.

SYSTEMATIC AND SPECIES ACCOUNTS

FAMILY GEKKONIDAE

GENUS ARISTELLIGER

Thecadactylus GOSSE, 1851, p. 75 (in part).

Aristelliger COPE, 1861, p. 496.

Idiodactylus BOCOURT, 1870, in Duméril, Bocourt, and Mocquard, 1870-1909, p. 41, pl. 10, figs. 1a-1d.

Aristelligella NOBLE AND KLINGEL, 1932, p. 4, figs. 1-5.

***Aristelliger titan*, new species**

TYPE: A.M.N.H. No. 7503, a complete left dentary.

¹ *Hemidactylus peruvianus* Wiegmann of Peru has never been rediscovered and probably represents an imported species.

TYPE LOCALITY: The "lizard layer," Pleistocene or sub-Recent, from Dairy Cave, St. Ann Parish, Jamaica, British West Indies, collected by Harold E. Anthony, 1919-1920.

DIAGNOSIS: The largest known member of the genus, attaining an estimated adult snout to vent length of not less than 150 mm., differs not only in size from all of the other forms, in which

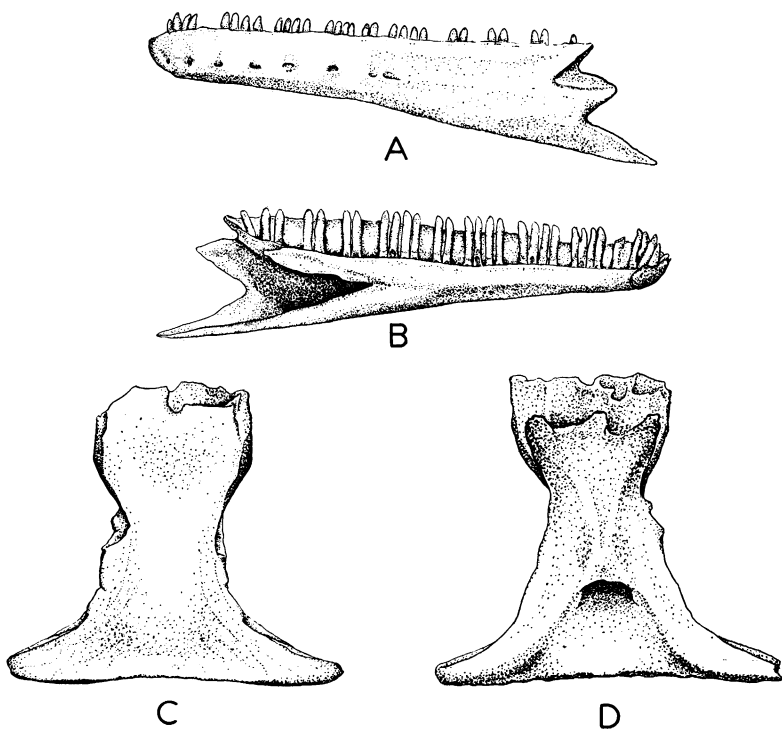


FIG. 1. *Aristelliger titan*, new species, from Dairy Cave, St. Ann Parish, Jamaica. A, B. Dentary (A.M.N.H. No. 7503), labial and lingual views, respectively. C, D. Frontal (A.M.N.H. No. 7504a), dorsal and ventral views, respectively. All $\times 2.5$.

the maximum snout to vent length does not exceed 135 mm., but also in having a greater number of maxillary teeth (37-40) and dentary teeth (40-42).

DESCRIPTION OF TYPE: The dentary (A.M.N.H. No. 7503) is 27.4 mm. long; its greatest height is 6.0 mm. (fig. 1A). It bears 31 teeth, but there is a total of 42 sockets. The ventral border has a slight, even concavity. The posterior border has three tri-

angular projections: a dorsal projection, a larger middle one, and a very strong ventral one. There is a moderately deep scar for the coronoid, which extends forward to the level of the penultimate dental socket. The ventral border of the coronoid scar is approximately parallel to the ventral border of the dentary and is located at a level about one-third of the depth of the mandible below the dental border. The angular leaves no scar and apparently abuts the dentary by edge-to-edge contact.

Beneath the bony anchors of the pleurodont teeth, the lingual surface of the dentary is produced medially as a prominent shelf. This shelf extends from the symphysis back to the level of the last tooth. On the upper surface of this shelf there is a deep groove that separates the edge of the shelf from the bases of the teeth. Beneath the shelf there is a deep triangular incisure extending forward (fig. 1B) to the level of the eleventh socket (counting from the posterior border). This incisure is bordered above by a moderately deep scar, representing the limit of overlap by the splenial upon the dentary. The splenial scar is acutely triangular in form, extending forward to the level of the fourteenth dental socket (counting from the posterior border). The entire dentary is hollowed by a deep conical fossa for Meckel's cartilage. The bone is thin at the symphysis, and there is indication of a loose attachment with the other ramus of the lower jaw. At the symphysis there is a flat tubercle for the insertion of the tendon of the mylohyoideus anterior. Other than this there are no muscle scars.

The teeth are simple, unicuspid, homodont, and pleurodont. Their crowns are blunt, nearly straight, and curved lingually. With the exception of the recently replaced teeth, most teeth bear a fossa at the base.

It is apparent from the lingual view (fig. 1B) that the type of tooth replacement in *A. titan* is similar to that of *A. lar* Cope (fig. 2). In *A. titan* every third or fifth tooth is missing. These missing teeth are probably equivalent to those teeth in figure 2 that have two replacement teeth beneath the original tooth and have excavated this tooth more than halfway. The basic pattern of tooth replacement in *Aristelliger* is that of alternate replacement. The secondary wave of tooth replacement is alternate upon the primary wave. It therefore appears that the secondary wave is represented in the type of *A. titan* as an empty socket and in *A. lar* as a tooth, with two replacement teeth at its base. There are

eight nutritive foramina on the external surface of the dentary, the position of which can be marked as beneath the fourteenth, seventeenth, twentieth, twenty-third, twenty-sixth, and twenty-eighth teeth (counting from the posterior border).

PARATYPES: There are 12 other dentaries (A.M.N.H. Nos. 7505a-7505l) available from Anthony's Dairy Cave collection. None of these is in the almost perfect condition of the type. All have the posterior border as well as the teeth missing. They are identified as *A. titan* by the position of the nutritive foramina and general conformation of the bone. These specimens represent

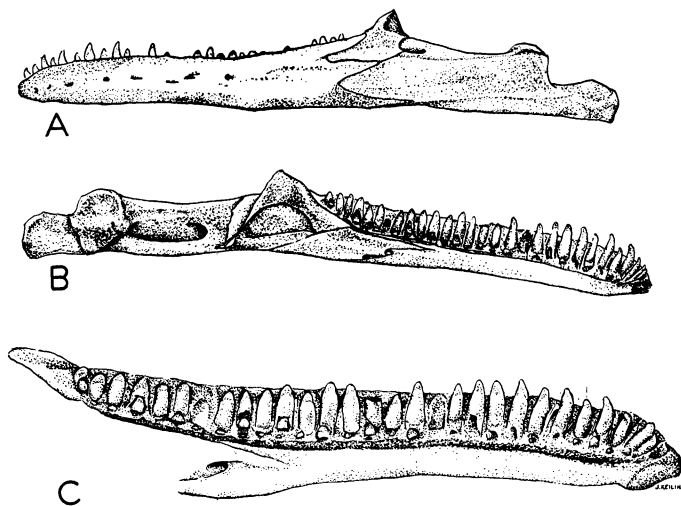


FIG. 2. Dentary of *Aristelliger lar* Cope (A.M.N.H. No. 50272), from Samana, Dominican Republic. A, B. Labial and lingual views, respectively, $\times 2.5$. C. Lingual view to show tooth replacement, $\times 5$.

animals of smaller size than the type, although all but one are larger than the dentary of the living Jamaican species.

REFERRED MATERIAL (A.M.N.H. Nos. 7504-7509,
M.C.Z. Nos. 1985-1989)

DENTARIES: The smallest dentary (A.M.N.H. No. 7505m) from Dairy Cave collected by Anthony is incomplete, with the teeth missing, and may represent the living dwarf species, although it probably represents a young *A. titan*. This specimen is not considered part of the paratype series because it cannot be

allocated to species with certainty. A single dentary (M.C.Z. No. 1985), with the anterior portion completely missing, is known from Portland Cave. It was associated with other remains of *A. titan* and represents a lizard as large as, or larger than, any of the living species. About three-fourths of the posterior portion of the dentary is complete and well preserved with but a few teeth missing.

FRONTALS: The largest frontal from Dairy Cave (A.M.N.H. No. 7504a) is almost complete (see fig. 1C). At its widest point, at the base where it abuts the parietal, it measures 17.0 mm. Its length along the midline is at least 15.0 mm.; perhaps 3 to 5 mm. should be added to this measurement, because the three processes that meet the nasals to cover the posterior portion of the olfactory stalk are missing. The minimal interorbital distance is about 6.2 mm. The dorsal surface of the bone is completely smooth and slightly depressed in the middle. The ventral surface shows the typical fusion of the lateroventral processes of this bone to form the canal surrounding the olfactory stalks. The posterior opening of this canal is very small, approximately 1.5 mm. wide. The anterior opening is much enlarged, about 4.8 mm. wide, located about 7.8 mm. in front of the posterior opening. There is a well-marked ridge on the dorsal surface of the canal, suggesting that the olfactory stalk is divided into two branches at this point.

There are 18 other frontals from Anthony's Dairy Cave collection. These range in size, along the median line, from 7.0 mm. (smallest) to 17.0 mm. (largest). The 18 specimens can be arranged in a growth series, with more than 50 per cent of the specimens estimated as being larger than, or equal to the maximal size of, the living dwarf species, *A. praesignis*. All these frontals most probably represent *A. titan*.

There is a smaller frontal (M.C.Z. No. 1986b) from the Portland Cave collection. The base and the posterior portion are incomplete, but the anterior part is intact. The length along the median line is 17.0 mm. The median process, one of the three frontal processes that meet the nasals, is the only one present in this specimen. It is strongly ossified, extending 5 mm. beyond the most anterior portion of the ventrally fused, lateroventral processes that enclose the olfactory stalks. The ridge on the dorsal surface of the canal is well marked, continuing forward to the tip of the median process. The minimal interorbital length is 4.4 mm. It is noteworthy that nearly one-third of the total length of the

frontal is taken up by the median process in this specimen. If the same proportions hold true for the Dairy Cave specimen, then the 15 mm. given above as the total length for A.M.N.H. No. 7504a would actually represent only two-thirds of the length.

Another frontal from Portland Cave (M.C.Z. No. 1985a) is available, but is so fragmentary that no measurements can be made that are useful in comparing it with other fossil and living material. It represents the largest in the collection.

A series of frontals of *A. titan* (A.M.N.H. Nos. 7504b-7504d) are outlined in figure 3 in order to show the variation in the form and structure in this bone. If the extremes of this growth series were to be compared, it would appear that two different forms were present. A comparison of the various frontals shows that

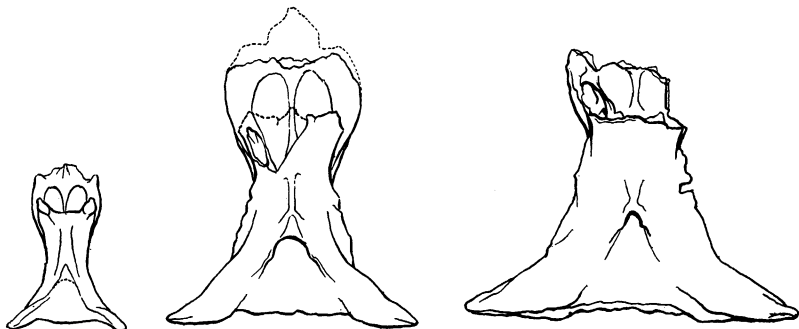


FIG. 3. Ventral views of frontals of *Aristelliger titan* (A.M.N.H. Nos. 7504b-7504d, from left to right), from Dairy Cave, St. Ann Parish, Jamaica, showing growth changes. All $\times 2.5$.

this is actually a case of differential growth. Apparently there is more rapid growth in the anterior part of the medial line than in the posterior part. As a result the posterior opening of the olfactory canal is proportionately farther posterior in the larger specimens than in the smaller specimens. There is also lateral rapid growth along the frontoparietal line. As a result the frontal flanges are much longer in the larger specimens than in the smaller ones.

A comparison of the frontals of different size groups of living *A. praesignis* shows the same phenomenon. In fact, frontals of the same size as those of *A. titan* and *A. praesignis* have the same general shape and proportions. This is apparently true of the other species of the genus.

PARIETAL: The parietal is represented by a single, almost complete bone (A.M.N.H. No. 7507) from Dairy Cave, collected by Anthony (see fig. 4A). The frontal edge forms an almost straight line except for some minor breaks. There are a slight ridge and a groove along the median line, indicating the fusion of the two

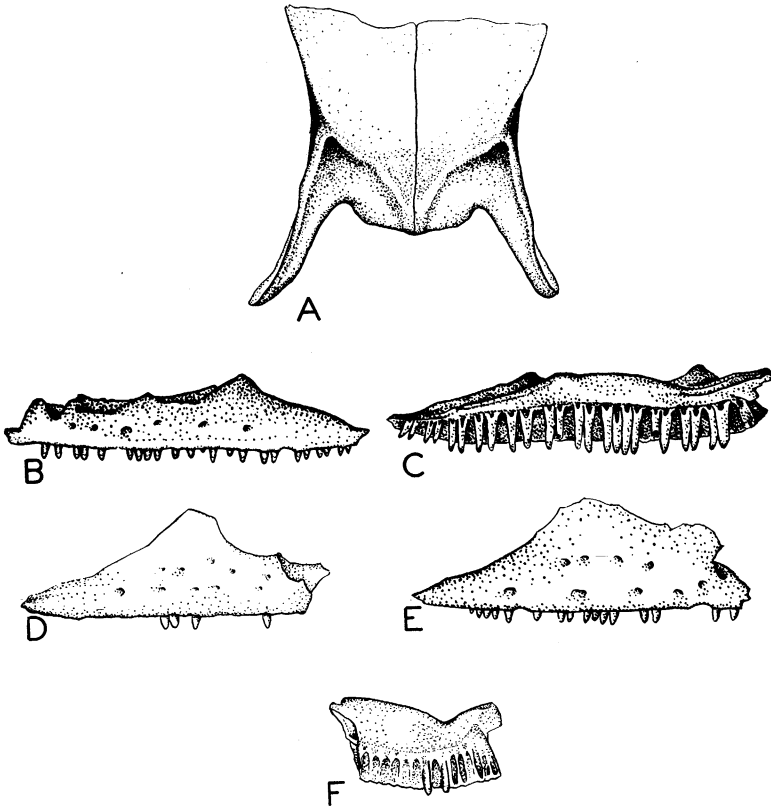


FIG. 4. *Aristelliger titan*, new species. A. Parietal (A.M.N.H. No. 7507), from Dairy Cave, St. Ann Parish, Jamaica, dorsal view. B, C. Maxilla (M.C.Z. No. 1989), from Dairy Cave, St. Ann Parish, Jamaica, labial and lingual views, respectively. D-F. Fragments of maxillae. D. A.M.N.H. No. 7506a, from Dairy Cave, labial view. E. M.C.Z. No. 1985a, from Portland Cave, Clarendon Parish, Jamaica, labial view. F. A.M.N.H. No. 7506b, from Portland Cave, ventral view. A is $\times 5$; B-D are $\times 2.5$.

parietal elements. The length along the median line is 5.7 mm.; the width along the frontal edge is approximately 7.0 mm. The dorsal surface is flat and smooth. Posteriorly, there are con-

cavities on each side of the median ridge extending to the supra-temporal process. The process is only slightly arched downward, in contrast to that of the living forms which is more strongly arched. The ventral surface of the parietal has rather deep concavities on each side of the ridge-like median suture. At right angles to the median ridge another ridge extends across the parietal from one edge to the other.

MAXILLAE: The largest maxilla (M.C.Z. No. 1989), with a perfect ventral surface, is from Dairy Cave (see fig. 4B, C) and was collected by Williams, Koopman, and the Hechts. The maximum length along the external surface is 19.7 mm. There are 25 pleurodont teeth, plus 12 empty sockets. The teeth, similar to those on the dentary, are arranged in a straight line except for the anterior series, where, at the level of the fourth tooth (counting from the front to the back), the line curves inward. The teeth are placed in groups of two, with empty sockets on either side. Only one group consists of four teeth (see fig. 4C). This is probably an indication of the manner of tooth replacement. In the living species, *A. praesignis*, the external surface of the maxilla is triangular in outline, with the dorsal part turning inward to make contact with the prefrontal and nasal. The upper part of the triangle, the nasal process, is missing in the fossil (M.C.Z. No. 1989), but is described below from other material. Six nutrient foramina are present on the external surface. Viewed laterally, the dental border forms a straight line.

Viewed ventrally, the palatal shelf of the maxilla is prominent. This surface of the shelf is quite irregular, with a marked tendency to dip inward. Anteriorly, the shelf forms two projecting processes, one internal and one external. The weakly developed external maxillary process is much more prominent than the internal process, and points internally and forward. There is a vomeronasal notch behind the internal maxillary process at the level of the fifth anterior tooth. This marks the position of Jacobson's organ. The edge of the palatal shelf turns inward at the level of the eighteenth tooth socket (counting from the rear), where a slight projection is formed. Behind this projection, the palatal shelf slopes gently outward to the level of the last tooth, where it disappears into the maxilla itself.

There are fragmentary maxillae (A.M.N.H. No. 7506) in the Anthony collection from Dairy Cave. Some of these fragments have parts of the nasal process (e.g., A.M.N.H. No. 7506a; fig.

4D), as well as the posterior portion of the bone, intact. One (A.M.N.H. No. 7506b) has the anterior portion complete, with the vomeronasal notch (fig. 4F). There is an even curve, gently sloping upward, marking part of the orbit. The height of the curve reaches 6.5 mm. in the largest fragment measured, at 10.2 mm. anterior to the end of the maxilla. A specimen of *A. lar*, the largest living species of the genus, with a snout to vent length of 116 mm., has a maximum height of this curve of 6.0 mm., at a point 7.8 mm. in front of the posterior end of the maxilla. This indicates that all the above-described material exceeds the largest living species in size.

A nearly complete maxilla (M.C.Z. No. 1985a), 17.0 mm. long (fig. 4E), is available from Lower Portland Cave. Only the most anterior portion of the bone is missing, that is, the section beginning at the level of the vomeronasal notch. There are 35 teeth (including the empty sockets) in the bone; estimating from other specimens, the missing section probably contained five more teeth. Therefore the fragment is certainly identifiable as *A. titan*, inasmuch as no other species of the genus has more than 33 maxillary teeth. Unlike the specimen described above (M.C.Z. No. 1989), the nasal process of the maxilla is nearly complete. However, the palatal shelf is broken on the internal border. The posterior border of the nasal process forms a curve, sloping gently upward and forming a border of the orbit. At the height of the curve, where the process would make contact with the prefrontal, the distance to the dental border measures 6.0 mm. This point is 10.0 mm. anterior to the last part of the tooth row, opposite the twenty-fourth tooth socket (counting from the rear). At the height of the nasal process there is a break that extends to the borders of the external nares. Therefore it is possible to say that the nasal process would attain a greater height (at least 1 or 2 mm. more) in a complete maxilla.

There are a variable number of nutrient foramina on the external surface, which can be arranged in four groups. The first consists of five foramina linearly arranged about 1 mm. above the dental border. Above the middle foramen can be seen three or four other foramina that compose the second group. The third series of foramina is located 2.5 mm. above the border of the maxilla, in an area between the levels of the middle and last foramina of the first series. The last group is composed of two foramina located in the region of the external narial border.

AXIS: Two axes (A.M.N.H. Nos. 7508a, 7508e) are known from Dairy Cave, collected by Anthony. Only one (A.M.N.H. No. 7508a) is complete, measuring 4.0 mm. from the tip of the neural spine to the centrum (fig. 5A-D). The neural spine is strong, compressed, resembling in lateral view the blade of a pole-ax in shape (fig. 5D); it is produced forward and anterior to the prezygapophysis. The base of the neural spine grades into the neurapophysis. The prezygapophysis is small, with indistinct facets; the postzygapophysis extends backward and slightly outward, with its articular facets directed ventrolaterally. These facets are oval in form. There is a distinct, although obtuse, ridge from the prezygapophysis to the tip of the postzygapophysis dividing the neurapophysis into two flat planes, a nearly horizontal dorsal plane and a vertical lateral one. The latter is narrow and strap-like in form, joining the centrum ventrally.

The neural canal is quite large, approximating a Byzantine arch in shape; it is slightly higher than wide. The floor of the canal bears a blunt, median ridge formed by the mound of the dorsal part of the centrum. The anterior face of the centrum is semi-circular in form; its convex border is ventral and slightly convex anteriorly. The odontoid process borne by the anterior surface of the centrum is less than one-half of the width and less than one-half of the depth of that surface. Nevertheless it extends considerably forward. The odontoid process is somewhat wedge-like in form, with its dorsal surface smooth and a strong transverse ridge at the junction of its ventral surface with the anterior central surface.

The posterior surface of the centrum is hollowed out about one-third of its length. The width of the concavity is about one-half of the width of the centrum. There are two processes on the ventral surface of the centrum, the catapophyses, which are directed backward, reaching a length equal to the odontoid process. These may represent the haemal spines. The width of the axis at the prezygapophysis is 2.5 mm. The length of the axis from the posterior end of the centrum to the tip of the odontoid process is 3.1 mm.

The other axis (A.M.N.H. No. 7508e) is larger, although part of the neural spine, the catapophysis, and the posterior part of the centrum, are missing. However, it is still possible to obtain the greatest height of this specimen, despite the fact that a small part of the neural spine is missing. It measures 6.2 mm. from the highest part of the broken neural crest to the ventral surface of

the centrum. This specimen would measure, if it were complete, over 7.0 mm., or nearer 7.5 mm. The length of the axis from the posterior end of the centrum to the tip of the odontoid process is 4.2 mm.

CERVICAL VERTEBRAE: Two cervicals from Dairy Cave, collected by Anthony, are available for study. The first (A.M.N.H. No. 7508b) is extremely short in proportion to its height and width, measuring 5.4 mm. in height and 2.1 mm. in central length (fig. 5E, F). The neural spine is complete, directed upward and backward, projecting to the level of the postzygapophysis. A straight crest runs along the midline from the anterior edge of the dorsal surface of the neural arch nearly to the tip of the neural spine. The neural spine distally is almost circular in cross section and it grades into the neurapophysis. The prezygapophysis is quite well defined and bears an almost circular facet, which points upward and inward. The postzygapophysis is quite strong, bearing an oval facet, which points outward and downward. There is no ridge between the prezygapophysis and postzygapophysis.

The neurapophysis is quite narrow anteroposteriorly, but when seen from in front, or from behind, it appears quite thick because of the parapophyseal crest. The parapophysis grades dorsally into the base of the prezygapophysis. Ventrally, the parapophysis ends in a blunt, somewhat wing-like process about the level of the middle of the height of the centrum. The parapophysis may be said to have the shape of a rod-like mound. There is no vertebro-arterial canal. The posterior edge of the neurapophysis forms a distinct mound at its junction with the centrum. The latter is very short in comparison to its width. It is badly damaged on the midline of the ventral surface and appears to have borne a blunt keel in this position. The centrum is amphicoelous, with deep cotyles, which are approximately circular and thickened ventrally. The very large neural canal is twice as high and twice as broad as the centrum. The canal is heart shaped in form, with the apex directed upward. On the dorsal (neural) surface of the centrum, there is an indistinct blunt keel.

A second posterior cervical vertebra (A.M.N.H. No. 7508f) is probably the fourth or fifth cervical, since there is evidence of a transverse process. This vertebra is badly damaged and only one measurement can be made: the interprezygapophyseal length, which is 5.2 mm. This indicates that this vertebra is of unusually large size.

THORACIC VERTEBRAE: There is an almost perfect thoracic vertebra (A.M.N.H. No. 7508c) available for study from Dairy Cave, collected by Anthony. It is 5.8 mm. in height, measured from the highest point of the neural spine to the ventral surface of the centrum. The neural spine slopes backward gently, reaching its greatest height probably at a point behind the postzyga-

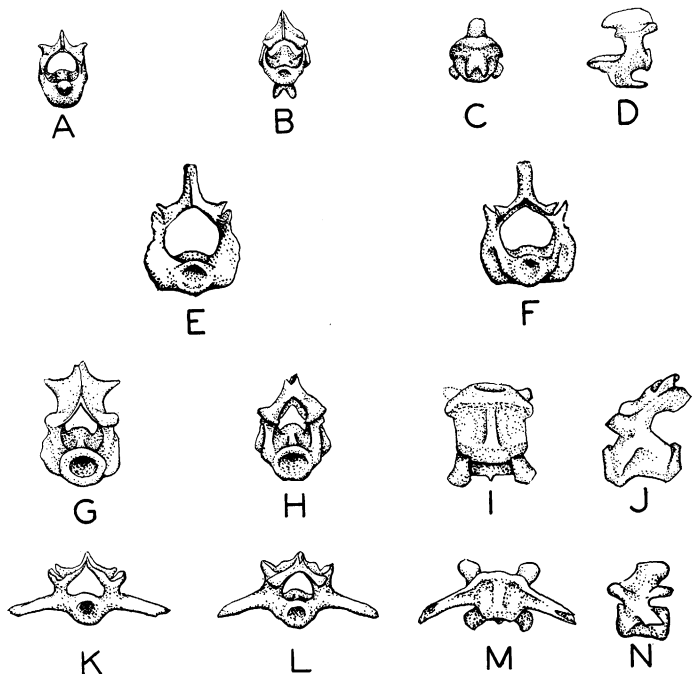


FIG. 5. *Aristelliger titan*, new species. Vertebrae from Dairy Cave, St. Ann Parish, Jamaica. A-D. Axis (A.M.N.H. No. 7508a), anterior, posterior, ventral, views, respectively. E-F. Cervical vertebra (A.M.N.H. No. 7508b), anterior and posterior views, respectively. G-J. Thoracic vertebra (A.M.N.H. No. 7508c), anterior, posterior, ventral, and lateral views, respectively. K-N. Caudal vertebra (A.M.N.H. No. 7508d), anterior, posterior, ventral, and lateral views, respectively. All $\times 2.5$.

pophysis (fig. 5G-J). The extreme tip of the neural spine is missing. The neural spine grades into the neurapophysis. The small postzygapophysis extending backward and slightly outward bears small, indistinct, oval facets. These are directed ventrolaterally. The prezygapophyses, bearing badly chipped facets, are small, extending forward and inward. An indistinct ridge runs from the

prezygapophysis to the tip of the postzygapophysis. An indistinct tubercle is present slightly posterior to, and below, the level of the prezygapophysis.

The parapophysis extends from the centrum up to the anterior part of the lateral surface of the neurapophysis as an elongated, lozenge-shaped mound. Behind the parapophysis, on the lower half of the lateral surface of the neurapophysis, is a large, triangularly shaped depression; its apex is rounded and directed dorsally.

The posterior margin of the neurapophysis is thickened, forming a distinct mound at its meeting with the centrum which is markedly amphicoelous. The cotyles extend deep into the centrum as conical hollows. The articular cotyle is slightly longer in width than in height. There is a high but blunt ridge on the dorsal (neural) surface of the centrum. In ventral view, the centrum shows considerable constriction in the middle and appears to be nearly as broad as long. There is a blunt keel on its ventral surface, which does not extend to either cotyle. A small circular nutrient foramen is present on either side of this keel slightly anterior to the midpoint of the centrum. The neural canal, nearly as broad as high, is somewhat cordiform, with its apex directed dorsally.

The width of the vertebra at the prezygapophysis is 3.9 mm. The length of the vertebra measured from the anterior portion of the centrum to the posterior is 3.8 mm.

Of five other thoracic vertebrae from Dairy Cave collected by Anthony, four have complete centra. Two specimens measured 3.5 mm. in length, one is 3.8 mm. long, and two are 4.0 mm. long. Only one (3.8 mm. long) had a complete prezygapophysis with an interprezygapophyseal length of 4.0 mm.

Six thoracic vertebrae from the Lower Portland Cave (M.C.Z. No. 1987) vary in length from 2.9 mm. to 3.2 mm. One almost complete vertebra, with a central length of 3.1 mm., had an interprezygapophyseal length of 3.4 mm. and a height of 4.4 mm. The tip of the neural spine is missing, and another 0.3 to 0.5 mm. should be added as a conservative estimate of the missing portion.

ANTERIOR CAUDAL VERTEBRAE: Of the three caudal vertebrae in the Anthony collection from Dairy Cave, only one (A.M.N.H. No. 7508d) is nearly complete (fig. 5K-N). This specimen has a central length of 2.5 mm. and a height of 4.1 mm., but most of the

neural spine is missing. Probably 1 mm. should be added to arrive at the real height.

The neural spine, pointing posteriorly, is hook shaped; its tip does not project back to the level of the postzygapophysis. It is weakly compressed and grades into the neurapophysis. The prezygapophyses are conspicuously larger than the postzygapophyses and bear guttiform facets. These are directed upward and slightly inward. The dorso-anterior border of the neural arch is broken into a V-shaped notch that lies between the two prezygapophyses. The postzygapophysis has oval facets directed downward and outward. There is a very distinct ridge between the prezygapophysis and postzygapophysis. A pair of strong, elongate, transverse processes extend from the sides of the centrum and lower portion of the neurapophysis. The base of the transverse process is fully as wide as the neurapophysis. The tips of the transverse processes are broken, but it appears that each was fully as long as the width of the centrum. Each process is slightly curved and directed backward and downward.

The centrum is about as long as wide and deeply amphicoelous. The cotyles are deep and wide, with a thick rim. A blunt keel runs along the middle of the ventral surface of the centrum separating a pair of concavities, which extend onto the lower surfaces of the base of the transverse processes. A pair of nutrient foramina lie on each side of the median keel at about the midpoint of the length of the centrum. There is no keel on the neural surface of the centrum, but there is a definite concavity. The neural canal is heart shaped and about as large as the anterior face of the centrum, but slightly wider than high. The interprezygapophyseal length is 4.1 mm. The remaining two vertebrae are severely damaged, but complete central measurements of 2.4 and 3.0 mm. were made.

A COMPARISON OF THE JAMAICAN SPECIES OF *ARISTELLIGER*

A comparison of the largest dentaries of *Aristelliger titan* and *Aristelliger praesignis* reveals a striking size difference (fig. 6). The *Aristelliger praesignis* illustrated here is from the owl-pellet deposit of Antrim and represents an individual of about 80 mm. in snout to vent length. A comparison of the two dentaries shows that the dentary of *A. titan* is about twice the size of that of *A. praesignis* and therefore must represent an individual of about 160 mm. in snout to vent length.

Comparisons of the vertebrae and of the parietals reveal no

differences between the living and the fossil species other than greater size and the associated increased ossification. The maxillae and dentaries show no great differences except for the greater number of teeth in *A. titan* and its larger size. The teeth of *A. titan* are proportionately higher than those of *A. praesignis* but not proportionately wider. As a result, a greater number of teeth is present in *A. titan*.

The perfect preservation of the dentary of *A. titan* makes possible a close comparison of it with a dentary of *A. praesignis*. In

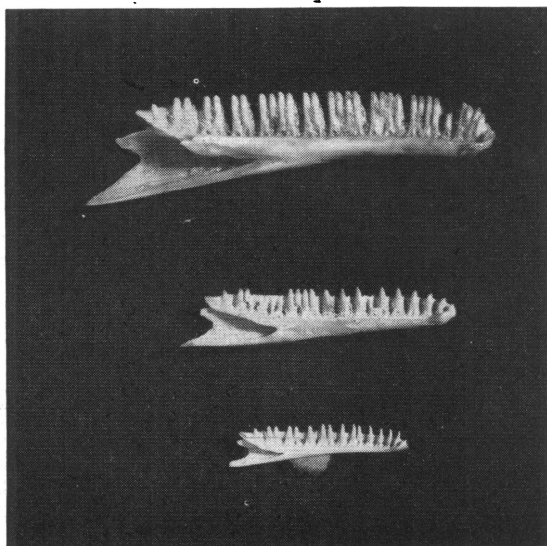


FIG. 6. Lingual views of dentaries. Top: *A. titan*, type. Middle: *A. lar* from Deep Cave, St. Michel de l'Atalaye, Haiti. Bottom: *A. praesignis* from Antrim, St. Ann Parish, Jamaica. All $\times 2$.

A. titan the coronoid incision reaches the level of the penultimate tooth in contrast to the condition in *A. praesignis* where the coronoid scar does not even reach the level of the last tooth. On the lingual side the splenial scar of *A. titan* reaches the level of the fourteenth tooth, whereas in this 80-mm. *A. praesignis* the splenial scar reaches the level of the ninth tooth. Other than these minute differences, intermediate structural stages of which can be found in *A. lar*, the dentaries are very similar.

The frontals of *A. titan* differ from those of *A. praesignis*. As

stated previously, the differences are primarily ontogenetic. Frontals of the larger *A. titan* apparently develop wide flanges on the frontoparietal line. These distinct flanges are missing in all *A. praesignis*.

TABLE 1
COMPARISON (MEASUREMENTS IN MILLIMETERS) OF LIVING AND
FOSSIL SPECIES OF *Aristelliger* (*Aristelliger*)

	<i>praesignis</i>	<i>georgeensis</i>	<i>lar</i>	<i>titan</i> ^a
Length from snout to vent	79	94	116	—
Length of dentary	12.0	14.4	18.0	27.4
Length of maxilla	12.8	15.0	19.5	19.7
Length of frontal	9.0	11.5	12.5	20.0+
Basal width of frontal	6.6	7.8	9.8	17.0
Interorbital width of frontal	2.6	3.0	3.6	6.2
Number of teeth				
Dentary	30/31	28/29	30/30	—/42
Maxillary	31/31	28/28	32/32	—/37

^a Measurements are of the largest fragment or complete bone available.

TABLE 2
VARIATION IN THE NUMBER OF TEETH IN LIVING AND
FOSSIL SPECIES OF *Aristelliger* (*Aristelliger*)

	<i>praesignis</i>	<i>georgeensis</i>	<i>lar</i>	<i>titan</i>
Dentary				
Range	28-33	28-31	28-33	38-42
Mean	29.7	29.5	30.5	40.0
No. of specimens	18	4	5	2
Maxillary				
Range	27-28	29	28-32	37-40
Mean	27.6	29.0	29.0	38.5
No. of specimens	5	2	11	5
Maximum snout-vent length	85	115	135	—

Comparisons of osteological characters of the living species of *Aristelliger* with those of *A. titan* can be seen in tables 1 and 2. In these tables the greater size and the greater number of teeth on the dentary and maxilla are further noted. A complete skull of a specimen of *A. lar* with a snout to vent length of 116 mm. is shown in figure 7 for comparison with illustrated elements of *A. titan* (figs. 1, 4).

DISTRIBUTION OF *Aristelliger titan*

The age of the cave deposits in Jamaica is no older than the Pleistocene. This is indicated by the lack of new faunal elements, as new genera, and by the similarity of the fossil mammalian and reptilian faunas with the living faunas. All of the fossil forms, with three exceptions, have been identified with living Jamaican genera. Some of the species are identical with those inhabiting Jamaica today. Reports on some of these faunal elements are now in press.

Fossil *Aristelliger* is known from three localities in Jamaica. As previously described, the extinct *A. titan* occurs in Dairy Cave only in the older strata. It is represented by a single maxilla where it occurs with abundant remains of *A. praesignis* (M.C.Z. No. 1990). Nowhere else do these two species occur together. In the upper levels of Dairy Cave, *Aristelliger* is replaced in abundance by iguanids of the giant anole group.

The Portland Cave deposit has abundant remains of *A. titan*. The accompanying fauna indicates that this deposit may be as old as, or a little younger than, the lizard layer of Dairy Cave. It has been suggested that the comparatively "old" fauna of the Portland deposit is a result not of the age of the deposit but of the peculiar geographic and ecological position of the areas. The Portland ridge is connected to the mainland by lowlands which bear evidences of marine inundation. Therefore at various times, some of them very recent, the Portland area was an island. In light of the fact that relict forms are found in this region, it may be that, if certain species such as *A. titan* survived under these isolated conditions, their remains indicate an older age for this deposit than the actual time of deposition. In other words, on the ancient Portland island there may have been a survival of an "old" fauna to a later period.

A single frontal (A.M.N.H. No. 7509) from a seaside cave in the Healthshire Hills was collected by Anthony. Exact locality data are unknown, but by appearance this bone is of more recent age than previously mentioned collections. The mammal fauna also indicates lack of more ancient elements, but it is not certain whether or not the mammals were associated with the *Aristelliger*. In appearance, the color of the bones of *Aristelliger titan* is most similar to that of what is probably pre-Columbian *Oryzomys* from the same locality, and of the same age, if both are from the same

cave. Anthony mentioned in his field notes but one fossiliferous cave in the Healthshire Hills. If this is a recent deposit, then *A. titan* in this area may be of the same relict fauna as that of the

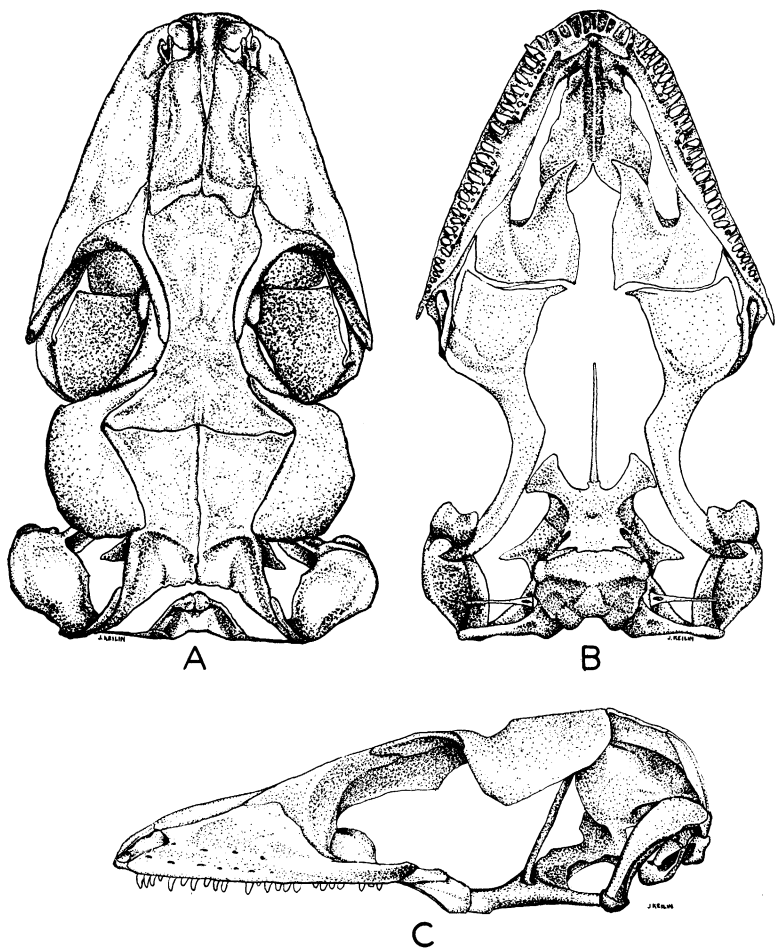


FIG. 7. Skull of *Aristelliger lar* Cope (A.M.N.H. No. 50272), from Samana, Dominican Republic. A-C. Dorsal, ventral, and lateral views, respectively. All $\times 2.5$.

adjacent Portland region. These two areas probably had a similar history.

Aristelliger lar COPE

A large collection of lizard bones from Deep Cave, near St. Michel de l'Atalaye, Departement de l'Artibonite, Republic of

Haiti, is in the United States National Museum collections. The most abundant remains in this deposit are of *Anolis ricordii*, a giant anole, found throughout the island today. Slightly less abundant are remains of a large *Celestus*. From this same deposit there are five dentaries and 10 maxillae that are identical with those of the living species, *Aristelliger lar*. The modern distribution of *A. lar* in Hispaniola is probably relict, and its present range is disjunct. *Aristelliger lar* is now known only from the southwestern peninsula of Haiti (Departement de l'Ouest and the Departement du Sud) and the Samana Peninsula of the northeastern coast of the Dominican Republic (fig. 8). The discovery of these fossils in a totally new area near the Plaine de Hinche, Departement de l'Artibonite, shows that the present distribution is relict and that at one time the species probably occupied most of the island of Hispaniola.

A comparison of the fossil remains of *A. lar* with examples of all living forms shows that all the fossil material represents a lizard larger than any *A. praesignis* of Jamaica, but that only two of the fossil maxillae and one of the dentaries were as large as the equivalent parts of a skeleton of a 116-mm. (snout to vent length) *A. lar*. Yet the living species attains a maximum size of nearly 135 mm. from snout to vent. It is not possible to determine at present whether this difference in the maximum size of the fossil and living samples is real or merely the result of the size and behavior of the species of barn owl responsible for the deposit.

DISCUSSION

DISTRIBUTION OF THE SPECIES OF *Aristelliger*

The genus *Aristelliger* is restricted to the Caribbean area. It can be divided into two subgenera, *Aristelliger* and *Aristelligella* (Hecht and Hecht, MS), which are defined on the basis of the structure of the terminal shields surrounding the claws, the maximum size, and the color patterns of the component species. The most valuable character in the study of fossil material is the maximum size attained by the various skull bones. An examination of the skeletons, particularly the skulls, reveals few structural differences among the living species of the genus.

The monotypic subgenus *Aristelligella*, occurring on Navassa, the southwestern peninsula of Hispaniola, and Great Inagua, can be distinguished osteologically by its small size (snout to vent

length not exceeding 60 mm.) and by its lower number of dentary and maxillary teeth (fewer than 24 on either bone).

The subgenus *Aristelliger* is composed of four large species: *Aristelliger georgeensis* inhabiting the islands off the coast of Central America; *Aristelliger praesignis* from Jamaica, Cayman Islands, and Swan Islands; *Aristelliger lar* from the island of Hispaniola; and a still undescribed species from the southern Bahamas (see fig. 8). In a paper now in preparation, it is shown that the subgenus *Aristelliger* is the more primitive group and that *Aristelligella* is a more specialized derivative (Hecht and Hecht, MS). All living forms of the subgenus *Aristelliger* attain a snout to vent length greater than 60 mm. The smallest member of the subgenus is the Jamaican species, *A. praesignis*, which attains a maximum size of 85 mm. and becomes mature at 45–50 mm. The next largest is *A. georgeensis*, attaining a maximum size of 115 mm. and maturing at 80–90 mm. The largest species, *A. lar* of Hispaniola, attains a maximum size of 135 mm. and is mature at 110–120 mm. The new species from the southern Bahamas is known by three specimens, all of which attain a snout to vent length greater than 60 mm. It probably resembles *A. praesignis* in growth pattern. *A. praesignis*, the smallest species, is geographically surrounded by larger species. With the discovery of the fossil, *A. titan*, from Jamaica, an interpretation of the interrelationships of this genus is now possible.

RELATIONSHIPS OF *Aristelliger titan*

Before the discovery of the giant fossil *Aristelliger* from Jamaica, it was deduced that, since *A. praesignis* is surrounded on all neighboring islands by larger species, there were two possibilities to explain the size of the ancestral *praesignis*. The first is that the ancestral form was of the same size as, or smaller than, *praesignis* and that independently *A. georgeensis* and *A. lar* attained a greater size. The second possibility is that *A. praesignis* was descended from a giant form and independently attained a smaller maximum size and breeding size. With fossil evidence now available it appears that the latter explanation is more probable. Whether *A. titan* was the direct ancestor of *A. praesignis* or *A. titan* is a slightly modified derivative of the basic stock of the genus cannot be determined. It is possible that *A. titan*, or a closely related form, was the direct ancestor, and with changing ecological conditions was replaced by the dwarf derivative.

In *Celestus*, the only anguid on Jamaica, there is a situation similar to the one presented above. Within historical times there were apparently a giant and a dwarf species of the same species group. A large member of that species group is available from the same deposits from which the *Aristelliger* material was obtained. The exact relationship of the giant anguid fossil to the recently extinct giant is not yet clear. There also remains the possibility that more than one species of *Celestus* is represented in these fossil deposits.

From the available evidence it appears that *A. titan* is an older species than *A. praesignis*, and that for a short time the two species inhabited the same island. This association apparently resembled the relationship in Hispaniola today, where a giant species and a dwarf species occur sympatrically (fig. 8), and even on the same trees, laying their eggs in the same holes. Whether there is a competition for food between these two species or not is unknown at present, but it seems improbable because of size differences.

RELATIVE AGES OF THE CAVE DEPOSITS

In order to give support to the proposed phylogenetic position of the giant gecko *A. titan*, it is necessary to consider the relative ages of the cave deposits in which it was found. Unfortunately the various layers in the different caves are difficult to correlate stratigraphically. As previously stated, the collections are Pleistocene or sub-Recent in age. *A. titan* was associated with the abundant remains of at least one giant species of anguid lizard, *Celestus*, in the lizard layers of the Dairy Cave collections. Since it contains the greatest number of extinct mammalian genera, this is probably the oldest cave deposit in Jamaica. The associated mammalian remains consist of seven bat genera and a single rodent genus. Among the bats, Koopman and Williams have observed that *Tonatia* is a genus new to the West Indies, and *Brachyphylla*, which has been exterminated on Jamaica, is still extant on Hispaniola. The differences between the fossil collections and the living fauna suggest that the lizard layer is of greater age than collections made in the same cave by the 1950 expedition.

In the interior parts of the cave, new bone pockets were found in 1950. In them, the fossil reptile material was not so abundant as in the original Anthony collection. It was possible, however, by careful sifting of the sediments, to obtain fragments of lizard

bones. In a collection made in the western side of the cave, a single maxilla of *A. titan* and a series of *A. praesignis* were found. These two species of *Aristelliger* were associated with the remains of several living species of bats. In a small pocket beneath the above deposit, remains of recent bats were collected. Unfortunately no reptiles were found in this layer.

The collections from the Lower Portland Cave on the southern coast of Jamaica are apparently of the same age as, or slightly younger than, the Anthony collections from Dairy Cave. Here again *A. titan* is associated with one genus of bats no longer found on Jamaica, and with another that recently became extinct. No bones of *A. praesignis*, the living species, were found in this deposit.

As previously shown by Miller (1926, 1929), the fossil deposits from St. Michel de l'Atalaye, Hispaniola, are of very late age. The fact that these deposits contain the remains of so many forms now extinct or at least exterminated in this part of Hispaniola indicates the amount of extermination or extinction that has been, and is, taking place in the West Indies. From the limited distribution of the living species, it would appear that the genus *Aristelliger* is probably a latecomer to the Greater Antillean fauna.

ORIGIN OF THE CAVE REMAINS

Miller (1929) and Anthony (1919) both believed that these remains in Hispaniola and Cuba were formed from owl pellets as a result of predation by barn owls. In the Hispaniolan deposits Wetmore (1922) found a new giant barn owl.

The 1950 expedition also collected an owl-pellet deposit of recent age on the property of Mr. Jack Lewis of Antrim, which is near the village of Runaway Bay, Jamaica. I estimate that the time of deposition of the bulk of this collection was between 25 and 100, most probably 50 or 75, years ago. Koopman (in press) has prepared a description of the deposit.

The commonest component of the deposit consists of mammals, mostly *Rattus*. Among the associated bird remains are those of barn owls. Three lizards are fairly abundant in this owl-pellet deposit. These are *Anolis garmani*, *Celestus hewardi*, and *Aristelliger praesignis*, in the order of abundance. Other fragmentary reptile remains are distinguished by their great rarity.

Celestus is represented by premaxillae, maxillae, dentaries, posterior elements of the lower jaw (exclusive of the coronoids,

which are always missing), quadrates, pterygoids, frontals, parietals, axes, cervical, thoracic, sacral, and caudal vertebrae, humeri, femora, complete pelvic girdles, and osteoderms. *Anolis garmani* is more abundant than *Celestus* and is represented by as many types of bones as is *Celestus*. *Aristelliger* remains consist of dentaries, maxillae, frontals, vertebrae, and a single pelvis.

If a comparison is made with the lizard layer of Dairy Cave, it is found that in the latter deposit *Celestus* is most abundant and *Aristelliger* is a poor second. A giant anole, *Anolis garmani* (or some close relative), is extremely rare. In the case of the remains of *Celestus* the parts that are represented in the lizard layer are the same in kind and relative abundance as those found in the recent owl-pellet deposit of Antrim. They are preserved in the same condition, and the same elements are missing. Dairy Cave *Aristelliger* remains differ only in the additional presence of the single parietal. The similarity in the two deposits substantiates the hypothesis that the lizard layer and the other cave layers were formed from barn-owl pellets.

A comparison of the limb bones of the living species of *Aristelliger* and *Celestus* does not reveal much difference in the relative ossification. A comparison of the other elements, missing in the fossil *Aristelliger*, does show that the living *Celestus* has a heavier and more ossified axial skeleton. However, it does not appear that the relative difference in ossification of the skeleton should result in the great disparity of the kinds of bones preserved. Perhaps the hard exoskeleton of osteoderms protects the bones of *Celestus*, allowing the more fragile elements to be preserved, but *Anolis garmani*, which has no exoskeleton, has the same types of bones preserved in the recent deposit. The frontal bone of *Aristelliger* is not sturdy as compared to the frontal of *Celestus*, yet it is frequently preserved in the lizard layers and in the recent deposit. This suggests that there is another factor involved in the preservation of these bones.

The disparity in parts preserved suggests that there is a difference in the technique of the predator in capture and feeding and that this technique varies with the species of lizards. Despite this possibility it is believed that the relative abundance of genera is a true picture of the feeding habits of the owl. The sturdy construction of the dentary and maxilla in most lizards, and in these genera particularly, supports the hypothesis that this frequency is a true picture of relative predation.

A comparison of the various strata of fossil and recent owl-pellet remains shows changes in the abundance of the lizard genera found in the deposits. A table of relative abundance is included (table 3), but it should be emphasized that the percentages are only approximations based on frequencies of dentaries and maxillae; consideration was taken of the size of the samples. The strata are divided into three categories, the oldest, the intermediate layers, and the recent deposit. The lizard layer of Dairy Cave represents the oldest known (bearing *Aristelliger*). The frequencies of lizard elements of the Portland fauna appear to be similar to those found in the lizard layer. The intermediate layers actually represent a composite picture of several small samples with younger faunal elements than the lizard layer. Some of these are more recent than others, but they all present approxi-

TABLE 3
COMPARISON OF FREQUENCY OF LIZARDS IN JAMAICAN OWL-PELLET DEPOSITS

	Order of Abundance	I	II	III
Recent (Antrim)				
Giant <i>Anolis</i> ^a		55%		
Small <i>Celestus</i> ^b			40%	
<i>A. praesignis</i>				5%
Intermediate (composite, Dairy Cave)				
Giant <i>Anolis</i> sp.		40		
Small <i>Celestus</i> sp.			35	
<i>A. praesignis</i>				24
<i>A. titan</i>				1
Oldest (lizard layer, Dairy Cave)				
Giant <i>Celestus</i> sp.		95		
<i>A. titan</i>			4.5	
Giant <i>Anolis</i> sp.				0.5

^a *A. garmani*.

^b *C. hewardi*.

mately the same picture. The owl-pellet remains at Antrim are taken as a sample of a recent owl-pellet deposit.

A comparison of the relative abundance of *Aristelliger* from the older layers to the recent deposits of Antrim shows a drop from second position (table 3) in the lizard layers to an extremely poor third in the Antrim owl deposit. A question arises as to whether or not the lowering of the frequency of *Aristelliger* could be as-

sociated with the replacement of the giant form by the dwarf form on Jamaica. At this point it should be noted that *Anolis garmani*, abundant in the Antrim collection, is the largest lizard extant on Jamaica, and is probably as large as *A. titan*. It seems that the owls are not preying on the most abundant lizards, but rather on lizards of a size that facilitates capture. The commonest species of lizards on Jamaica are probably anoles, but the largest, *A. garmani*, is not the commonest species. In fact, in frequency it is probably the lowest, but its great size, bright coloration, and slow movements make it an easy victim for the predator and the collector. The remaining smaller anoles are conspicuous by their absence from the Antrim collection, and by their great scarcity in other collections. It appears at this point that the owls have been preying selectively, and perhaps the size and habit of the lizard prey are more important than their relative abundance. If the above is true, then there remains the possibility that the actual predation by the owls was directly involved in the extinction of the giant gecko and in its replacement by its dwarf. A similar replacement through time of a giant species by a dwarf relative is shown by these same data (table 3) in relation to the anguid *Celestus*. As the giant species of *Celestus* and *Aristelliger* are replaced in time by dwarf relatives the frequency of *Anolis garmani* steadily increases in these remains.

A study of the relative size of the living species of *Aristelliger* represented in the Antrim owl-pellet remains indicates that the owl is preying on the larger size groups of the living *Aristelliger prae-signis*. It can be estimated that the smallest individual represented in this collection was not under 65 mm. in snout to vent length. The most abundant remains are those of the largest age groups, which were animals over 75 mm. in length. This is in contrast to the alcoholic specimens available in museums and those collected by the 1950 expedition. In these collections of recent *Aristelliger* the most abundant size groups are under 60 mm. The relative size of the lizards found in the owl pellets is about the same as that of the smallest individuals represented in the collections of *Aristelliger titan*.

Further evidence that the owl is the chief collecting agent of these remains is that the largest lizard inhabiting Jamaica, until recently,¹ is totally absent in all these remains. The genus

¹ *Cyclura* has become exterminated on Jamaica in the last decade.

Cyclura, an iguanid, is much too large to be preyed upon even by a giant species of owl. The extinction of the Jamaican species was caused by the mongoose and by man.

Aristelliger is a crepuscular lizard, rarely abroad in the daylight. Its time of activity probably corresponds closely to that of the two owls of Jamaica. This perhaps explains the abundance of this gecko in the owl-pellet collections and in the cave deposits, in contrast to the relatively low frequency of gekkonids as fossils from other types of deposits (Hoffstetter, 1946). This scarcity may be due to the frailty of the skeletal elements of gekkonids and their resulting susceptibility to crushing in true sedimentary deposits.

SUMMARY

A new fossil species, *Aristelliger titan*, from Dairy Cave, St. Ann Parish; Portland Cave, Clarendon Parish; and Healthshire Hills, St. Catherine Parish, all in Jamaica, is described. Remains of two living species, *Aristelliger praesignis* (Hallowell) from Dairy Cave, St. Ann Parish, Jamaica, and *Aristelliger lar* Cope from St. Michel de l'Atalaye, Haiti, are discussed. The fossil *A. lar* represents a new locality, indicating a retracted distribution for the living species.

Aristelliger titan is the largest known member of the genus and may have been the ancestor of *A. praesignis*. There is a replacement in time of the giant species, *A. titan*, by the smaller, *A. praesignis*. This may have been the result of selective predation.

A comparison of the fossil cave deposits with a known post-Columbian owl-pellet deposit from Antrim, St. Ann Parish, Jamaica, suggests that the accumulation of lizard remains in the caves of Jamaica and Hispaniola was made by barn owls.

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