It would be useful to extend the comparison to higher frequencies by a consideration of the arrival times of optical and x-ray pulses.

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Cynodont Reptile with Incipient Mammalian Jaw Articulation

Abstract. *A diagnostic mammalian character is jaw articulation between squamosal and dentary bones, replacing the quadrate-articular joint of reptiles. A newly discovered Argentinian Middle Triassic form shows, for the first time in an ancestral reptile, definite evidence of a squamosal-dentary articulation supplementary to the persistent primitive connection.*

Diagnostic characters separating reptiles and mammals have mainly to do with functional features or "soft" anatomy. There is, however, one osteological character highly useful to the student of phylogeny and paleontology. Mammals have abandoned the primitive jaw joint between quadrate and articular in favor of a new articulation between the squamosal bone of the skull and the dentary, which makes up the entire mammalian lower jaw. During this shift the half dozen other bones originally present in reptiles dwindled and disappeared from the jaw, and the quadrate and articular were transformed, together with the pre-existent stapes, into the mammalian series of ear ossicles.

Until recent years the reptile-mammal distinction in jaw articulation was clear-cut in the fossil record. The older, Mesozoic, fossil mammals are in general poorly known, but lower jaws are not infrequently found; in every case there is a distinct condyle on the dentary, obviously for articulation with the squamosal. Among mammal-like reptiles the dentary is much enlarged, but in every case reported the old quadrate-articular joint persisted.

In recent years the situation has become somewhat clouded. There is evidence that in at least some early mammals jaw elements other than the dentary were still present and that a vestigial quadrate-articular connection, in addition to a fully developed squamosal-dentary articulation, persisted for a time in some forms (*1*). Crompton (*2*) has described from the late Triassic Cave sandstones (? Rhaetic) of South Africa a form (*Diarthrognathus*) in which, in addition to the quadrate-articular joint, the dentary was in contact with the squamosal. This type, hence, is a structural intermediate, but it cannot be considered as an evolutionary reptile-mammal transition form, because true mammals were already in existence at the time of its appearance. The phylogenetic position of *Diarthrognathus* (whether reptile or mammal) is uncertain, and other features of its anatomy show that it is not affiliated with the typical cynodonts from which most, if not all, mammals descended.

Until the present the therapsid side of the picture has remained clear-cut. In the Lower Triassic of South Africa there are a number of carnivorous cynodonts (of which *Cynognathus* is best known) which quite surely represent an early stage in the reptile-mammal transition, in such features as the beginning of a secondary palate and enlargement of the dentary bone of the jaw with relative reduction of the other jaw bones. The articulation of the jaw, however, remains solely between quadrate and articular.

I am currently studying members of the family Chiniquodontidae, later representatives of this carnivorous cynodont line, present in the Middle Triassic of South America. Two genera of this family, *Chiniquodon* and *Belesodon*, from the Santa Maria beds of Brazil were described some time ago by von Huene (*3*). His material was so inadequate that little could be told of their structure; I am currently redescribing their skull structure from better material obtained by a Harvard expedition (*4*), and am, further, describing two additional genera from the slightly earlier Chañares beds of Argentina (*5*). The chiniquodontids show an advance over the Lower Triassic members of the group in certain regards, notably an increase in extent of the secondary palate to essentially the mammalian stage.

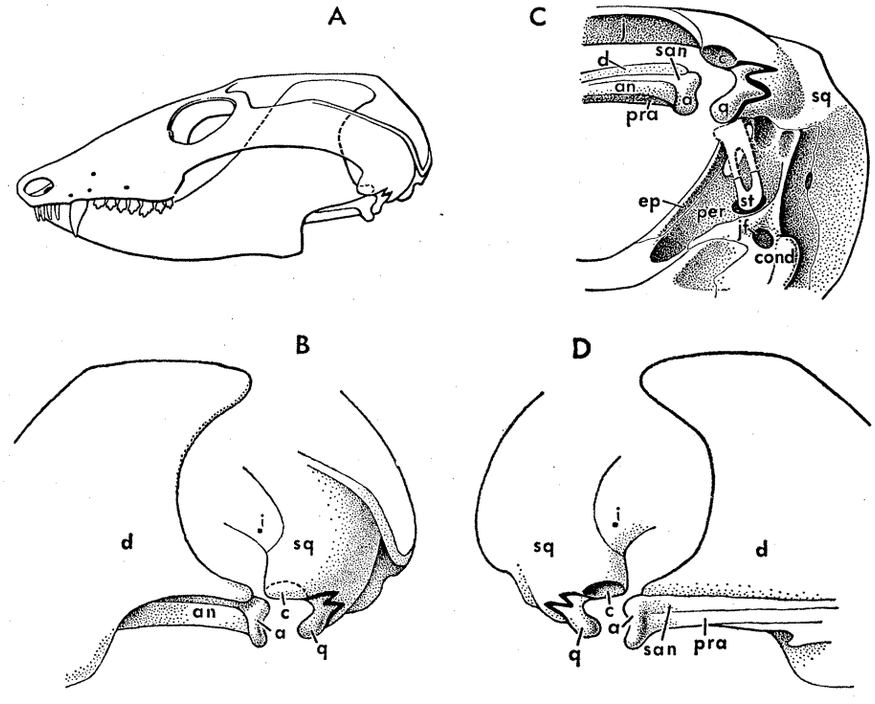

Fig. 1. (A) Side view of the skull of *Probainognathus*. (B), (C), and (D) Lateral, ventral, and medial aspects of the articular region of the left side of the skull and jaws. In each case the jaw is disarticulated and drawn slightly forward. Abbreviations are: *a*, articular; *an*, angular; *c*, incipient condyle on squamosal; *cond*, occipital condyle; *d*, dentary; *ep*, epipterygoid; *j*, jugal; *jf*, jugular foramen; *per*, periotic; *pra*, prearticular; *q*, quadrate; *san*, surangular; *sq*, squamosal; and *st*, stapes.

In three of the four chiniquodontid genera, articulation between skull and jaw is still technically of the old quadrate-articular type. The quadrate (with which the quadratojugal is combined) is a small element rather loosely lodged in a pair of notches in the squamosal; the articular is likewise small in size, forming the posterior end of a bar of bone braced against the inner surface of the large dentary; this bar is formed by angular, surangular, and prearticular elements. The posterior end of the dentary lies just above and slightly lateral to the articular, and close to the squamosal near the point where the quadrate is inserted. There is no osseous connection in these three genera between dentary and squamosal, but in consideration of the feebleness of the quadrate and articular, it is probable that the dentary and squamosal functionally took part, through joint ligaments, in jaw support. In a fourth chiniquodontid genus, from the Chañares beds, which I am formally describing elsewhere as *Probainognathus* (*6*), an articular connection between squamosal and dentary is definitely developed. The squamosal extends far down over the cheek, external to the back end of the dentary. On its inner surface here, just above and anterior to the point of quadrate articulation with the articular bone, is a rounded depression with distinct boundaries in which was obviously received the outer surface of the posterior end of the dentary. This is surely the initiation of the articulation which was later to become the more highly developed glenoid-condyle articulation of the mammal.

What is the phylogenetic position of *Probainognathus*? One type of argument is that we should term a mammal any form in which a squamosal-dentary articulation has been initiated. This seems unreasonable here; after all, *Probainognathus* is in other regards very close indeed to the other chiniquodontid genera, and is very far from attaining mammalian conditions in such important features as braincase construction. On the other hand, there are no known features which would bar *Probainognathus* and its close relatives from a position ancestral to mammals of the later Triassic. It is highly probable that we are here dealing with a cynodont close to, if not actually on the line of ascent to the class Mammalia.

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Hepatic Influence on Splenic Synthesis and Release of Coagulation Activities

Abstract. *Isolated rabbit liver perfusates contain one or more puromycin-sensitive factors that stimulate factor VIII and IX activities in splenic perfusates. Production of coagulation activity by a complementary process involving organ perfusates suggests existence of coagulation factor precursors. An analogy is made to appearance of high factor VIII activity after plasma transfusions in von Willebrand's disease.*

Activities of factors VII, VIII, and IX that are puromycin-sensitive appear in isolated rabbit organs perfused with oxygenated fluid containing 30 ml of homologous red cells that were washed six times, 60 ml of human albumin (6 percent in Tyrode's solution), and 10 ml of 3.8 percent trisodium citrate (*1, 2*). The washed, packed suspension of red cells also contained platelets and white blood cells. This perfusion fluid contained no coagulation activities, and thorough flushing of the organs with Tyrode's solution followed by preliminary perfusion for 1 hour eliminated most of the stored coagulation factors. The mechanics of perfusion were carried out with a modification of the liver perfusion method of Miller (*2, 3*) adapted for splenic perfusion.

An isolated rabbit liver and spleen were perfused simultaneously as described above, each by an independent circuit. Most of the sequestered coagulation activities were removed from the organs by preliminary 1-hour perfusion with separate volumes of fluid. This initial perfusate, termed the "flush," was then removed, and the respective system was washed thoroughly with Tyrode's solution. Fresh perfusate was then added, and the perfusion was continued for 4 additional hours, the final perfusion period (*1, 2*). However, after 30 minutes of this final perfusion period, the effluents from both perfusion reservoirs were reversed so that the liver effluent now perfused the spleen and the spleen effluent, the liver. In some experiments, puromycin (25 mg) or cycloheximide (4 mg) was added to the perfusates during the final perfusion period. A series of control experiments included identical perfusion of liver-kidney and spleen-kidney combinations. Periodic samples of perfusates were taken, and assays for coagulation factors were performed as described (*1, 2*). Factor VII was assayed in a one-stage system with canine plasma deficient in factor VII (*4*); factors VIII and IX were assayed by the partial thromboplastin method, with canine plasma deficient in factors VIII and IX (*5*). Coagulation activities were expressed as a percentage of that obtained with a pooled standard of normal rabbit plasma which was assigned a value of 100.

Factor VII activity remained unchanged when the effluent of one organ was perfused though the other. When liver effluent was added to the spleen, however, factors VIII and IX activities were markedly different from those of spleen perfusions (*1, 2*). In contrast to these results, addition of spleen effluents to the liver circuit did not alter the coagulation activity.

Figure 1 shows the mean activity of factor VIII from 12 simultaneous liver and spleen perfusions without puromycin and from 6 parallel experiments with puromycin. Figure 2 shows the mean activity of factor IX from these same experiments. The passage of liver effluent through the spleen produced a rapid increase in both factors VIII and IX activities. Each activity reached a peak in 45 to 60 minutes, approached its normal level in plasma, and then declined rapidly. In the presence of puromycin, the liver effluent was without effect on coagulation factor activity in the spleen. The same results were obtained when cycloheximide was used as an inhibitor. Figures 1 and 2 show results of the reverse experiments in which spleen effluents were perfused through the liver. No stimulation of either factor VIII or IX activity was observed. Control experiments with liver-kidney or spleen-kidney perfusions did not show stimulation of factors VII, VIII, or IX activities be-