Translation of selected pages of:

Goldfuß, A. 1831. Beiträge zur Kenntnis verschiedener Reptilien der Vorwelt. *Nova Acta Physico-Medica Academiae Caesareae Leopoldino-Carolinae Naturae Curiosorum*, 15:61–128.

by P. Martin Sander

Preface: This translation only includes the sections of the paper by Goldfuß that either describe preserved soft parts or paleobiological inferences. I retained both the paragraph structure and sentence structure and stayed as close as possible to the German original, sometimes at the expense of readability. However, I wanted convey the flavor of the early 19th century German as much as possible. The language employed by Goldfuß was typical of the time and predates standard modern spelling, a feature that I was unable to transfer to this translation.

p. 63, last sentence, to p. 65, end of first paragraph:

Whatever authority one is inclined to follow, the image of this animal always appears more like a painting produced by the boundless imagination of a Chinese artist and less like that of an actual product of nature. The outline of the head, the spacious chest, the upright, sitting posture, and the long wings announce a bird; however, where can a bird be found in living nature with pointed teeth and claws on the wings? The shape appears even more wondrous and divergent if one attempts to bring it into agreement with the familiar forms of living reptiles.

If one looks at the dentition and investigates the construction of the skull more closely, then the shape of a crocodile becomes apparent. If one imagines a crocodile sitting upright on the weak feet of a squirrel, the long front limbs of a bird, and with an ear finger that is elongated into a wing, then the mythical image of a winged dragon falls in its wondrous combination far behind this winged crocodile.

Thus, one is directed finally and by necessity towards the mammals, among which the bats also possess finger wings, with claws, small and thin tails, weak hindlimbs and pointed teeth.

Based on this construction, our wondrous animal was able, like the bats, to glide through the air with an extended flight membrane, climb up on steep walls, and hang on to rocks and trees; but like these, it had to pull itselve along laboriously on level ground.

The purpose of its flight was without doubt also the catching of insects, and the construction of the teeth does not argue against the assumption that it fed on insects, perhaps on these large dragonflies, the remains of which also occur in the lithographic limestone.

p. 105, second paragraph, to end of text on p. 109:

Without doubt, the animal was able to take up a sitting posture based on its pelvis and the length of its hindlimb, as squirrels do, and one would assume this to have been its usual posture if it were not for the far downward extended and long wing finger which would have been in the way of this posture. If the animal wanted to progress in a crawling fashion, it would have faced the same difficulties as the bats, and a jumping mode of progression must have been inhibited by the length and weight of the head and neck, as well as by the relative weakness of the hindlimbs. It is therefore obvious that these animals only used their claws to hold on to rocky slopes, crevices, and trees (if those were present) and climb up steep rock walls. As those (i.e., the bats), they were able to fly with their wings and probably hovered over the water's surface in order to catch insects, and possibly also water animals. Their wide throat and the weak but tall supports of the jaws lead to the guess that their teeth served more in holding on to the prey than in comminution of the prey. With the help of their long neck, which, without doubt, they usually carried curved backwards to balance the head, they were able to extend the head forward to reach prey, change the center of mass of the body, and thus were able to perform manifold turns during flight.

One is next asking the question of what was the kind of the cover of the body and the nature of the wing membrane? The basic character of the crocodile and the monitor lizard would lead one to expect a skin covered with shields or scales; the approximation to the design of the bird allows the possibility of a plumage; and the appearance of a feature similar to bats, as well as the cover of the monotremes that are similar to both mammals and reptiles, allow the guess that hairs were present. We obtain a surprising insight about this question through the examination of *Pt. crassirostris.*

The slabs of rock, which enclosed the parts of the skeleton, are of the well-known nature of the usual lithographic stone. Before the two slabs were separated, only on the lower fracture surface one could notice that the material was partially friable and nearly friable. When the slabs were split apart, it became apparent that the two slabs only were held together by the ingrown bones of the skeleton and, more distant from the skeleton, by protruding rough spots on the surfaces. Between the bones and in their immediate surroundings, the slabs were already separated and had smooth surfaces, the raised and depressed areas of which were lying closely on each other in a matching fashion. At these smooth areas, the stone material was modified, more friable, here and there allowing the removal of very delicate slivers, and had a different coloration. The rough areas, that kept the slabs in connection, are primarily located on the counter-slab (B.), particularly in the area behind the vertebral column and in front of the head. Above the head, there is a friable, white-colored, thin layer that can be split into thin flakes and completely removed; the remaining area is light ochre-yellow and yellowish-red in color; in front of the wing finger as well as behind the backbone with brighter and darker, somewhat bent cross-stripes. The lime mass which forms the infillings of the depressions in the skull is also white immediately under the bone. In both slabs, there is also a white, thinly laminated layer in front of the neck, from the skull to the chest (η.), and on the right slab one can see a

similar one (ϑ.) along the back, in which, however, the stone matrix is less friable. One layer of this splittable, friable stone material lies on the counter-slab between the forearm and the flight finger (ι.). The layer ends sharply cut off at the groove that is formed by the impression of the finger; and above, at the wrist it forms a gnarly protrusion, which is formed by a harder stone material, however. On the lower fracture surface, one can see that this layer has a thickness of 1/4 of a line and that it is only loosely connected with the lower stone mass. On the main slab (A.), this area is smooth, slightly lighter in color and, just as the more yellowish stone, can be removed between the ribs and arms here and there as thin splinters, below which the base of a rough and hard stone surface appears. On the counter-slab, these regions are smooth, hard, and vividly colored red-yellow.

The dissolved and friable state of the indicated areas resulted without doubt from the rotting of the soft parts of the animal, which also prevented the fusion of the stone material of both slabs. It may also have caused the different coloration and striping. The several-times-folded flight membrane was most suited for the intrusion of lime particles between its folds, which formed the laminated layers after the destruction of the soft parts. In these thin and delicate lime layers, the cover of the surface of the flight membrane was able to leave delicate impressions where it consisted of scales, hair or plumage that was not destroyed by decomposition before the hardening of the lime layer. But not only between the folds of the flight membrane, but also between the tufts of hair and feathers, fine lime particles were able to penetrate, and the impressions of these were thus possible in other places as well.

There can be no doubt that the described lime layer between the flight finger and the upper arms consisting of thin laminae must have originated from the flight membrane; one can even notice (μ.) a very smooth and clearly demarcated raised area on the counter-slab which must have originated from a fold or a muscle. If one looks at the lower fracture surfaces of both slabs, one can see the several wavy lines which indicate the superposition of denser and looser lime material, and which possibly were caused by the flight membrane covering the left arm, because only part of the same are visible between both arms. On these flight membranes, impressions of tufts and flocks of curved and alternately bent hair immediately catch the eye. On the counter-slab (B.), the traces show up as raised areas, but as depressions on the main slab. The hairs therefore originally were below the lime layer of the former slab. All hairs turn their tips downward and outward. In most flocks, one can distinguish between a somewhat more protruding middle raised area, from which the other, weaker ones appear to be diverging here and there. Stronger, isolated hair impressions lie between both forearms; and on the main slab in the white region on the back, there is the impression of a flaky, raised mane (ϑ.); and on the white region surrounding the anterior neck, there are forward pointing hair tufts (η.). The latter are also noticeable on the counter-slab, but instead of the back mane, one can see numerous nearly straight rays (χ.) which are formed by delicate, interrupted, striped impressions. They have a considerable resemblance to the feather beard of an ostrich feather. Even more similar to a feather are several delicate impression (λ.) on both slabs. On the indicated place, one can recognize the outline and delicate two-rowed striping of a small bird feather, but never finds a stronger keel. Also, a

magnifying lens does not make the weak image clearer but rather lets it disappear in that the coarser raised areas dominate. Slaty fragments of the counterpart that can be removed from its back sometimes have similar delicate impressions, and also on the plate that contains *P. medius*, one can see on both surfaces but especially on the lower, numerous lines and fibers that diverge like feather beards, and on the upper lateral belly area, a peculiar fibrous fabric, like in matted-down hair and feathers. The visible opening of two tubes the thickness of a rachis, that consists of a very thin substance and are filled in by dissolved lime particles, could be identified as rachides if more clear traces of a plumage could be found.

Thus, the *Pterodactylus crassirostris* was not covered by scales and shields like a reptile but by a fur of soft, nearly inch-long hairs, possibly in some places even by feathers. A similar cover can thus be assumed for its generic relatives.

p. 112, last two paragraphs of caption to plates

η. ϑ. ι. χ. λ. Impressions of hairs and feathers

μ. Impression of the wing membrane of the left wing