Physiology of the Impossible. Exner meets mythology.

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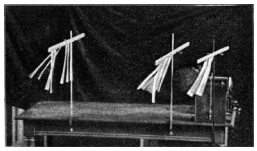
A naturalist's humiliation

Sigmund Exner, professor of physiology at the University of Vienna, used to spend his holidays in the Austrian mountains. On his long mountain hikes Exner often had a puzzling experience: From his elevated standpoint in the mountains he observed a buzzard in the valleys beneath him flying higher and higher and ending up moving in circles. In circling the buzzard constantly gained height - although its wings did not show any movement. How can a bird keep its body in the air and even gain height without flapping its wings? "Here we have a problem", Exner notes, "and in view of such a buzzard - in addition to the usual sensation of smallness and humbleness that man has in high mountain regions anyway - I felt the humiliation of a naturalist who faces a phenomenon but cannot explain it".

The self-made bird

The enigmatic behavior of the buzzards gave birth to a series of experiments that Exner published under the title *On the floating of birds of prey* in 1906 (*Über das Schweben der Raubvögel*). Exner's investigation started with a memory. On a trip to a meeting of naturalists in Breslau in September 1904 a scene came to his mind that he once had witnessed in a zoo. Exner's imagination presented to him some birds of prey lying on the cave floor, the outer feathers of their wings intensely trembling. Could this trembling be a kind of floating exercise? As the scientific object was inaccessible - too far away to be examined, unable to fly if caught – Exner constructed an artificial bird made of wire, wood, a buzzard's wing, and a motor. A rotating disc raised the wing, a strong spiral feather drew it back. In order to visualize the corresponding flow of air Exner used white paper strips.



In a second step he introduced two electrodes into a living buzzard's muscular system and by use of a Du Bois-Reymond induction apparatus he showed that a trembling of the wings could be provoked by electric impulses. Finally the stylus of a myograph inscribed the wing's vibrations. Exner's studies of these minute curves on the paper manifested a shift that according to Bruno Latour characterizes any scientific research about nature: "Scientists start seeing something once they stop looking at nature and look (...) obsessively at prints and flat inscriptions".

Exner meets mythology

Detail of Raphael, Galathea

Twenty years before the floating buzzard occupied Exners mind, some other flying objects had accompanied him on his mountain hikes: "Last summer", Exner noted in 1882, "certain figures from great masters' works of art followed me on my lonesome hikes through hills and ravines pushing themselves in the foreground and asking for an answer to their riddle". The riddle Exner refered to concerned those well-known saints, putti, and angels that painters had depicted for centuries. How could they keep their bodies in the air against the law of gravity? In 1882 Exner published his results under the title: *The Physiology of Flying and Floating in the Fine Arts* (Die Physiolgie des Fliegens und Schwebens in den bildenden Künsten).

Exner's text is confusing because of its ambivalent heuristics: The author cannot ignore the completely fictitious nature of floating bodies in art; nevertheless he treats them as if they should obey the authority of physics and physiology. It seems that even mythology cannot escape the laws of nature. Exner continues to use the language of proof and causality even when it comes to fiction, even when he faces the impossible.

Monsters

Exner imagined what a "realistic artist" who aims to depict "a meticulously exact imitation of nature" would have to paint in order to present a physiologically correct flying body. In the case of a sparrow the ratio of the weight of its muscles was to the total weight of its body as 1 was to 6. Thus, Exner calculated what a real flying man - given a weight of 60 kg - would look like. He would have wings and their supplementary muscles would weight 10 kg: "The result would be an enormous hump, whose dimensions would exceed everything we have seen so far, moreover, it would be located in the front. Our artist certainly would have constructed something which was able to fly but something which would not resemble a human being any more. It would be a monstrum, something from the workshop of a hellish Breughel".

A putto taken from Raphaels Galathea served to demonstrate the physiological and physical impossibilty of the phenomenon in question. Exner transformed the putto into a scheme. By taking into account the probable speed of the flying body, its hypothetical weight, the effect of gravitation, and the specific weight of air, Exner made some calculations. "The result is: the putto would advance at a speed of 54 m per second". Exner modified his formula by putting in a much more probable speed of 2 m per second. In that case the putto's weight would amount to a mere 2 g. "It would be easy to blow it in the air." Thus, Exner concluded: "The pictorial representation of a human figure that would really have the capacity to fly is impossible."

Sigmund Exner, Scheme of Raphaels Putto (a: suspension of the wings, ab: the body axis, de: resistence of the air, ef: gravity)

But what about floating? A floating figure would need to be weightless. That is: A group of saints floating upwards - as in Albrecht Dürer's *Anbetung der Dreieinigkeit* - would be an absurdity. At least, they would have no reason to keep their legs down, their heads up. The saint's hair would stand in all directions.

Albrecht Dürer, Anbetung der Dreieinigkeit, Vienna, Kunsthistorisches Museum

The two angels that hold the crown in Michelangelos Pietà in Rome would use their muscles in vain: They would fall down to earth together with the crown they seem to carry through the air.

A realistic naturalist

It would be too easy to accuse Exner of being naive, too easy to diagnose a fundamental misunderstanding of artistic imagination. It is far more rewarding to compare his speculations about the flying saints with his own research on flying. The interesting point is not what Exner tells us about painting but what his approach to art reveals about his own heuristics. One might wonder whether Exner's phantom of a "realistic artist" who aims to give "a meticulously exact imitation of nature" betrays the practice of the realistic naturalist. According to Exner the realistic idea of flight in painting would only be possible with beings that in reality were unable to fly. A realistic artist would have to construct "something", a mere thing, a "monster". Such a monster is Exner's bird-machine: a hybrid made of feathers and a motor, "something" that cannot float but allows the study of the conditions of floating. Thus, Exner's research on the floating buzzard is based on models that cannot float themselves: a self-made bird, an anaesthetized buzzard brought to life by electricity. If they were able to fly they would escape from the physiologist's laboratory.