Wie die Nase des Mannes...

Generations of giggling german school girls have grown up with the wisdom, passed down through the years, that

wie die Nase des Mannes, so sein Johannes.

Of course it's as much nonsense as is the similar story about the predictive power of the size of a man's feet (which was finally disproved in a peer-reviewed scientific paper published in 2002: see links). But I could not help thinking of the German phrase when perusing a paper in this month's Current Biology, with memories of a 2006 Developmental Dynamics paper still washing about somewhere in my addled brain.

Taking a cue from the order of concepts in the German phrase, I'll turn first to the 2006 paper: it was about growth of the nose or rather, since it was in birds, the growth of the beak. In that paper, Ping Wu and colleagues made a comparative study of the embryonic growth of the beaks of different birds ranging from ducks, which have long flat beaks (bills), chickens, which have short and curved beaks, and cockatiels which have long and curved beaks. They first established a simple time-course of beak development which allowed them to see when the beaks of the three species began to look different. They then focused on the different zones of a growing beak, and found that the relative rates of cell proliferation between the zones were different in different species, and that the differences could probably explain the different beak shapes formed. Having established this, the researchers went further to ask what was controlling proliferation in each site. To cut a long story short, they found that the levels of a signalling protein called BMP4 to correlate with proliferation. What is more, if they added extra BMP4 to chicks growing in their eggs, they got more beak growth and a larger beak, and if they inhibited BMP4 signalling they got small beaks instead. They discovered more, too, and whole thing added up to a nice story that links the places and strengths of BMP4 expression in the embryo's face to the final distinctive shapes of the beaks of different birds.

The paper by Ana Herrera and colleagues in this month's *Current Biology* also links bird embryology to bird evolution but this time the focus is not on the beak but on the male phallus ('penis', but avian biologists prefer 'phallus' to get away from assumptions drawn from mammalian

biology). There is a huge variation of genital structures between the males of different species of bird. About 3% of bird species have a phallus capable of intromission and in some species it is very long in relation to the bird's body: ducks and other anseriformes are a well-known example. In many species, for example chickens and other galliforms, a rudimentary phallus exists but it is far to small to enter the female's body, while in the neoaves (the group that contains almost all birds) there is no phallus at all and fertilization depends on accurate lining up of holes – the so called 'cloacal kiss'. The authors of the paper compared the embryos of ducks, which make adults with a long phallus, and chickens which make adults with a very small one. They observed that both kinds of embryo show similar phallus development at first but in the embryos of chicks, the end of the phallus undergoes massive cell death. In ducks, it does not.

Like Wu and colleagues, working on the beak seven years earlier, Herrera and colleagues sought an explanation at the level of molecular signalling and they discovered that the zone of cell death in chickens expresses large amounts of BMP4. The end of a duck phallus does not. Could the BMP4 control the cell death? To find out, the researchers placed a bead soaked in a powerful inhibitor of BMP4 signalling on the end of a chick embryo phallus, and found that the cell death was reduced and the phallus remained larger than in normal chick embryos: they even proved the point by treating just one side of the phallus and having just this one side remaining large instead of regressing. In a reciprocal experiment, they treated the developing genital area of duck embryos with BMP4 and showed that they showed the cell death normally associated with chickens, and the phallus regressed.

So, putting these papers together, it is perfectly true that the growth of the nose (beak) and the growth of the male genitals are under the control of the same molecule. But, alas for the folk wisdom of German Mädchen, the effects of this molecule operate in *opposite* directions in the two systems.

At least in birds. What happens in humans is still anyone's guess...

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LINKS OVERLEAF:

Links:

The 2002 paper debunking the myth about a correlation between the size of the foot and penis:
http://onlinelibrary.wiley.com/doi/10.1046/j.1464-410X.2002.02974.x/full

The 2006 paper on the role of BMP4 in promoting beak growth:
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4381996/

The current paper on the role of BMP4 in preventing penile growth:
http://www.sciencedirect.com/science/article/pii/S0960982213005034