holding my head on one side. This made life rather difficult, including watching television. It was this particular problem which led one evening to my laying the set on its side so that I could see it more clearly from my awkward position.

After an hour's viewing in this way I noticed that the colours on the screen appeared to be running. One side of the figures on the screen had a red shadow, and the other side a blue shadow, or, of course, since the set was on its side, the blue shadow appeared on the upper edges and the red shadow on the lower. Returning the set to the upright position cured the problem.

I thought about this for a bit, and I was about to settle for the probability that some bits had come loose inside the set when it occurred to me to carry out a little experiment. I laid the television set on its other side. I left it for half an hour and then returned, confidently expecting that I would now see the red shadow at the top and the blue at the bottom — but no! The red was at the bottom again!

This called for a lot more thought. Hypothesis after hypothesis raced through my mind, each to be rejected as fast as it occurred on the grounds of inconsistency, impossibility, or downright stupidity. Eventually only one hypothesis remained, and this was it:

Colours have weight, and red is naturally heavier than blue.

Thus the television set, not being adjusted for sideways operation, did not compensate for the weight of the colours.

I realized at once the possible implications, but, first of all, more evidence was required. To rush out and stop people in the street to tell them that red is heavier than blue, particularly when one is obliged to adopt a somewhat hunched-up stance with one's head on one side, might have invited comment of the worst sort, if not actual arrest. No, proof had to come first. I had to devise some experiments to support my hypothesis.

I decided to use as an experimental model a tomato plant, of which I had several at the time, growing against a sunny wall. I selected a medium-sized unripe tomato, hanging from a strong branch, and checked it for uniformity of greenness (I assumed that green would do as well as blue). I then measured its mean diameter, and the height above the ground in which it grew, and then just waited. It took a long time to ripen, but eventually it became uniformly red. I eagerly measured its height above the ground once more and discovered it to be a quarter of an inch lower than when it was green! The red tomato was heavier than the green!

But was this valid? I hastened to re-measure the size of the tomato in order to see if it had sneaked on a bit more mass in the intervening days, but it was here that things went wrong. The tomato had become much softer by this time, and my engineer's calipers were too much for it. It

collapsed in a squashy heap on the ground.

What I needed was a bit more sensitivity, so I devised a much more sophisticated experiment involving a vice, a razor blade, a 1-foot ruler (white), a saucepan, two desk lamps, and some sheets of red and blue plastic film. I fixed the razor blade in the vice, and balanced the ruler across it. (Have you any idea how difficult it is to balance a plastic ruler on a razor blade?) I then stuck some red plastic film over each of the desk lamps and carefully positioned them so that one shone on each end of the ruler. I forget what the saucepan was for. I then switched on the lamps and both ends of the ruler glowed red as it hung there on the razor's edge. I waited about a minute, during which the ruler remained balanced, and then I suddenly replaced one of the red plastic sheets with a blue one. For about twenty seconds the ruler remained where it was, one end red, the other blue. Then slowly the red end began to sink, and the ruler fell off!

Of course, I could not let the problem drop there. All sorts of questions clamoured to be answered, for instance, what is the order of weight of the colours? I set out to determine this by repeating the balancing experiment a number of times with differently coloured plastics, and after many hours of delicate balancing I managed to discover the relative weights of the colours. In order of weight, lightest first, they are: white, yellow, green, blue, orange, pink, red, black.

I have other experiments under way now, some involving coloured balloons filled with hydrogen sulphide, others involving the production of coloured bubbles from a mixture of detergent and Dulux emulsion, and, although the neighbours are beginning to complain, the results are looking very promising.

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The hand of *Archaeopteryx*

SIR — Hecht and Tarsitano¹ defend their interpretations of the homologies and morphology of the hand of the protobird *Archaeopteryx* against what they believe are distorting and misrepresentative criticisms by Howgate². However, Howgate is essentially correct on the issues. It is Hecht and Tarsitano who are misreading the data.

The hands of *Archaeopteryx* appear to be very similar to those of their potential ancestors, the predatory theropod dinosaurs. Hecht and Tarsitano suggest this resemblance is only superficial because "the digits of birds must be 2-3-4 based on embryological work"^{1,3-5}, while palaeontologists identify the digits in derived theropods as 1-2-3. Hecht and Tarsitano then ask "do the similarities observed by palaeontologists have greater weight than the evidence derived from

ontogeny by embryologists?"¹. What they fail to note is that Hinchliffe, whom they repeatedly cite in support of their argument, has cautioned that, "the embryological convention that digit 1 is missing (in bird embryos) is not based on firm evidence"⁶. Even bird embryos never have more than four digits, so there is no way to establish which digits really are present. Such unreliable data cannot be used to disprove the homology of theropod and bird hands, hence the palaeontological evidence does outweigh the embryological work. If theropods are bird ancestors, then the progressive loss of the outer digits from early dinosaurs to derived theropods shows that *Archaeopteryx* and birds retain digits 1-2-3.

Hecht and Tarsitano also continue to defend the possibility that the disarticulated joint between phalanges 1 and 2 on manus digit III is actually a break^{1,3-5}. The problem is that there is no evidence to support this idea. Having examined the Berlin specimen, I can confirm that the particular surfaces at this join are well preserved. Besides, this joint is present in all five of the articulated hands preserved in three specimens. Howgate was caustically critical of Tarsitano and Hecht's speculations on how these hands came to be "broken"². This is understandable, for the idea that all these hands suffered identical injuries is simply beyond reason.

The criticisms that Hecht and Tarsitano direct at the theropod-bird hypothesis are based more on procedural grounds than on the data. This is annoying since Hecht and Tarsitano are not themselves innocent of such methodological errors. It is also putting the cart before the horse. How the theropod-bird hypothesis has been erected and defended is not nearly as important as its validity. As for the hand of *Archaeopteryx*, palaeontological evidence shows it to be theropodian in design and homology.

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1. Hecht, M.K. & Tarsitano, S. *Nature* **309**, 588 (1984).
2. Howgate, M. *Nature* **306**, 644 (1983).
3. Hecht, M.K. *Evol. Biol.* **9**, 335 (1976).
4. Tarsitano, S. & Hecht, M.K. *J. Linn. Soc. Zool.* **69**, 149 (1980).
5. Hecht, M.K. & Tarsitano, S. *Geobios mem. spec.* **6**, 141 (1982).
6. Hinchliffe, J.R. in *Vertebrate Limb and Somite Morphogenesis*, 293 (1977).

Scientific Correspondence

Scientific Correspondence is intended to provide a forum in which readers may raise points of a rather technical character which are not provoked by articles or letters previously published (where Matters Arising remains appropriate).