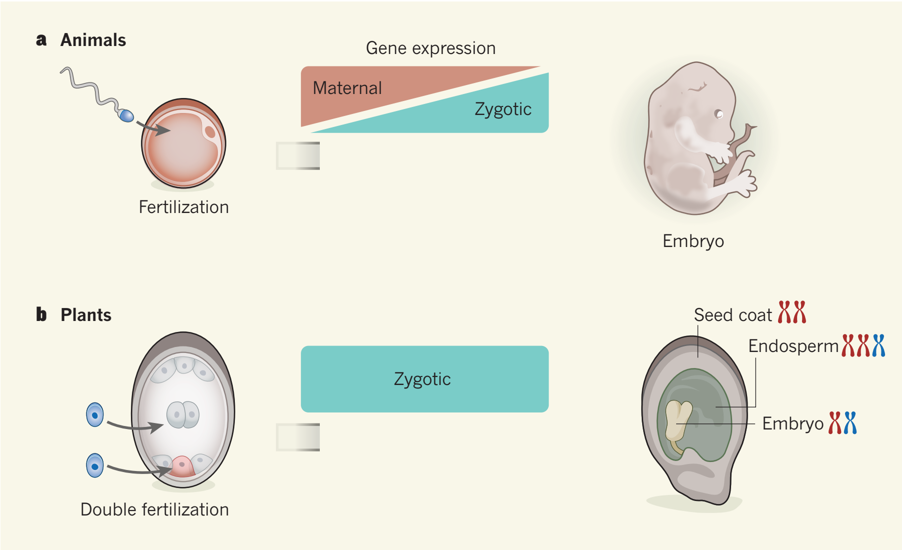

Figure 1 | Maternal-to-zygotic genomic transition in plants and animals. **a**, In animals, a single fertilization event between maternal and paternal gametes forms the zygote (not shown). Initially, the animal embryo is under predominant control of the maternal genome, and the zygotic genome is only gradually activated over the course of embryogenesis. **b**, In plants, a double fertilization process generates the zygote and the endosperm tissue. Both the endosperm and the embryo are encased in maternal tissue that generates the seed coat. Chromosome symbols represent maternal (red) and paternal (blue) genomes. Nodine and Bartel[3] show that, in contrast to the case for animals, the plant zygotic genome is activated almost immediately after fertilization.

embryos is derived from the maternal genome.

What might explain such different results between the two studies? Nodine and Bartel[3] suggest that the most likely answer is that the embryo samples of the earlier study were contaminated by maternal tissue. This is because, in *Arabidopsis* as in other flowering plants, the embryo is surrounded by a seed coat and other maternally derived tissue (Fig. 1), making the isolation of high-purity embryonic tissue difficult — a problem for the extremely sensitive genome-sequencing techniques used in both studies. After observing this maternal-contamination effect in pilot studies, Nodine and Bartel[3] overcame the problem by extensively washing the isolated embryo cells.

One question arising from Nodine and Bartel's study is why activation of the zygotic genome is so different between plants and animals. Because the two kinds of organisms evolved multicellularity independently[6], and have very different life histories, it is perhaps not surprising that the maternal-to-zygotic transition also differs between them. In plants, gametes are generated from cells derived from a pool of undifferentiated cells that are also responsible for generating structures such as leaves[7,8], rather than from a distinct germ-cell lineage as occurs in animals. In addition, fertilization itself is radically different in flowering plants compared with animals, with each seed being the product of two fertilization events (Fig. 1b). In this process, one fertilization event forms the endosperm, a tissue that is functionally similar to the mammalian placenta, and which contains two sets of maternal chromosomes and one set of paternal chromosomes. A second fertilization event results in the formation of the embryo. It is noteworthy that, although Nodine and Bartel show that the embryo experiences equal transcriptome contributions from both parental genomes, gene expression in the embryo-nourishing endosperm shows extensive parental influence[9]; these effects are due to uneven nuclear 'dosage' as well as to epigenetic imprinting effects.

Another question is how the early plant embryo coordinates rapid integration of two genomes and the concomitant activation of a resulting zygotic genome. In animals, a suite of mechanisms acts to clear maternal factors, such as proteins and RNAs, from the developing zygote and to activate the zygotic genome[1,10]. It is unclear whether similar mechanisms operate in plants. Tantalizingly, epigenetic processes such as DNA methylation and demethylation, as well as regulatory small RNA molecules, have recently been implicated[9] in the control of both gamete and endosperm development. Future studies of these pathways may reveal mechanisms for the regulation of gene expression in embryonic plants.

Understanding how a functional plant genome so quickly emerges from two progenitor genomes is vital for understanding plant development, and for informing approaches to plant breeding and plant biotechnology. In many crop species, combining two different parental genomes can generate regular and predictable hybrid vigour, known as heterosis. In some species this vigour is obvious very early in development[11]. Consistent with these observations, Nodine and Bartel's work[3] suggests that

NATURE

50 Years Ago

In a Cantor Lecture … Dr. Tom A. Margerison described how science could be presented on television not only to the specialist audience but especially to the layman. In spite of the absolute necessity of science and technology, the 10–15 per cent of the population who guide the destiny of Britain, the professional men, the majority of teachers, the industrialists, the politicians, are almost completely ignorant about science. The bridging of this gap in this most influential part of the population is of great urgency. There are many ways in which television can help to close the gap.
From *Nature* 3 February 1962

100 Years Ago

Mr. Harding's letter … reminds me of an experience which … may be of sufficient interest to place upon record in these columns … It must, I think, have been in 1866 or 1867 … that I had occasion to go from the West to the East End of London. Starting upon my journey about 10 p.m., it began to rain soon after I left the house in Bayswater, and I opened an umbrella, which, to my surprise, became stiffer and heavier every moment, and was found on examination to be so thickly glazed over with ice that it was impossible to close it. At the same time the pavements and roadway were also becoming uniformly glazed; pedestrian movement was most difficult, and all horse traffic was suspended. Although an experience of some forty-five years ago, the impression left upon my memory is still vivid — the ludicrous sight of people carrying ponderous and rigidly frozen umbrellas which they could not close, the stream of skaters down Oxford Street and Holborn, and the silence due to the absence of vehicles, all came to mind on reading Mr. Harding's letter.
From *Nature* 1 February 1912