50 & 100 YEARS AGO

50 YEARS AGO

The Baghdad Pact Nuclear Training Centre was formally opened by H.M. King Feisal II on March 31 in the presence of Ambassadors, Ministers and members of the Scientific Council of the Centre. The Centre has been founded by the Pact countries, Britain, Iraq, Iran, Pakistan and Turkey, to provide training in radioisotope techniques for scientists from the Pact countries and possibly other countries in the region… It is intended that the Centre should promote the application of radioisotopes and atomic energy in the region by collaborating with existing laboratories and research groups… The application of nuclear power will not be worthwhile in Iraq and Turkey in the foreseeable future, owing to the abundant supply of oil and hydro power. Iran and Pakistan are, however, interested in the potentialities of nuclear power units of medium output for some areas, and the Centre will help by advice to promote this development.

From *Nature* 11 May 1957.

100 YEARS AGO

The Journal of the Society of Arts for December 14, 1906, contains a paper read before the council of the National Fruit-growers' Federation by Mr. C. H. Hooper, on fruit-growing and bird-protection… It is satisfactory to see that Mr. Hooper speaks his mind plainly, without any attempt at special pleading for species which are notoriously harmful [and] advocates the relentless destruction of certain kinds and a restriction of the numbers of others… Mr. Hooper… urges that in fruit-growing districts it may be absolutely essential to kill off a percentage of blackbirds, starlings, and even missel-thrushes, thrushes, and rooks… A few more straightforward and outspoken addresses of this description, and there would perhaps be less nonsense talked and written about the duty of encouraging and protecting birds even where they are eating the unfortunate gardener and farmer out of house and home.

From *Nature* 9 May 1907.

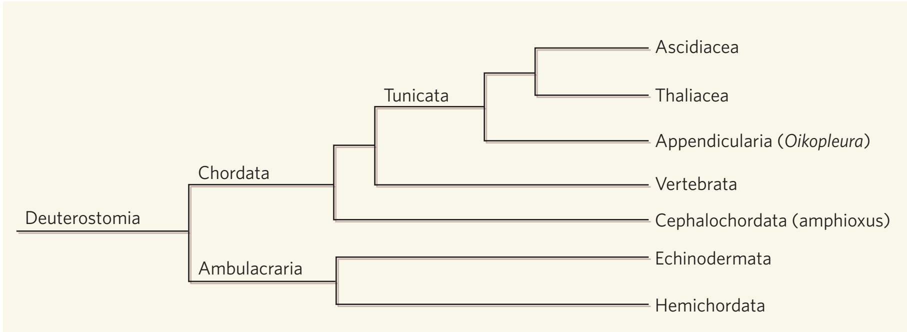

Figure 2 | Chordates in context. The Chordata and Ambulacraria are the constituent members of the Deuterostomia, a relationship that is based on molecular phylogenetic analyses, and is defined by certain fundamental aspects of embryonic development that they have in common. The phylum Chordata includes the subphyla Tunicata, Vertebrata and Cephalochordata. *Oikopleura dioica*, the subject of Cañestro and Postlethwait's research[1], is a member of the appendicularian tunicates. The exemplar of the cephalochordates is amphioxus. (Tree based on data in refs 4 and 5.)

amphioxus and vertebrates, retinoic-acid signalling regulates the anterior limits of Hox expression in the embryonic central nervous system (CNS) and certain other tissues. Retinoic acid acts by binding to heterodimers of the retinoic-acid receptor (RAR) and the retinoid X receptor (RXR), which in turn bind to retinoic-acid response elements (RAREs) in the regulatory regions of direct targets (including Hox genes), thereby activating gene transcription. Control of the levels of retinoic acid is exercised by a suite of proteins including retinaldehyde dehydrogenase (Aldh1a, which catalyses the conversion of retinaldehyde to retinoic acid), and another enzyme, Cyp26 (retinoic acid hydroxylase, which inactivates retinoic acid).

In vertebrates and amphioxus, excess retinoic acid severely perturbs embryonic development. In contrast, Cañestro and Postlethwait found that the same treatment has no apparent effect on the A/P patterning of *O. dioica*. The head/trunk is foreshortened. But the A/P extent of the activity of a β-galactosidase-like gut enzyme, and of expression of *Hox-1* and other developmental genes (three *Otx* genes and two *Pax-2/5/8* genes), is unaffected. This lack of effect is not altogether surprising, because *O. dioica* has lost Aldh1a, Cyp26 and RAR, as well as several Hox genes[6,7]. Moreover, unlike Hox genes in amphioxus and vertebrates, the remaining *O. dioica* Hox genes are not clustered together in the genome, and their expression along the embryonic A/P axis is only approximately co-linear.

Cañestro and Postlethwait make the point that although ascidians have retained genes for Aldh1a, Cyp26 and RAR, the ancestral-chordate mechanism of retinoic-acid signalling has undergone alteration in these tunicates as well. Although excess retinoic acid causes a foreshortened head/trunk in ascidians, and induces misplaced expression of *Hox-1*, RAR is not autoregulated as it is in amphioxus and vertebrates, and no RAREs have been found in ascidian *Hox-1*. As in *O. dioica*, Hox clustering is also disrupted in ascidians. Consequently, the authors argue that a breakdown of Hox clustering may be causally related to evolutionary changes in retinoic-acid signalling in all tunicates.

More broadly, however, the significance of their findings is twofold. First, the results put into relief a paradox — although tunicates are now generally agreed to be the sister group of vertebrates, their exceptionally rapid evolution has effaced much information that might have been useful for suggesting how the vertebrates evolved from chordate ancestors. Instead, they are excellent for understanding what evolution *can* do.

Second, the results raise a question. Why, if genes can be lost and developmental programmes greatly changed without loss of the fundamental chordate body plan, have amphioxus and vertebrates retained their early developmental programmes over half-a-billion years of evolution? The answer may lie in constraints imposed by the mode of early development.

Tunicates have evolved 'determinate cleavage': the fate of cells is set early in embryonic development, with reduced cell numbers (for example, the CNS of *O. dioica* has only about 100 cells and that of an ascidian larva about 330), and their genomes are evolving rapidly. In contrast, in amphioxus and vertebrates, in which the retinoic-acid-sensitive period for A/P patterning occurs relatively late in development, cleavage is indeterminate: cell fates are decided late, there are many more cells (an estimated 20,000 neurons alone in the amphioxus CNS), and genome evolution is relatively slow.

To date, there have been few studies of the possible relations between the timing of cell-fate decisions in development and rates of genome evolution. In the nematode worm *Caenorhabditis* (early decision of cell fate) there is more selection against duplicates of genes expressed very early in development than against those expressed late, suggesting that constraints on genome evolution are greater early in development[8]. On the other hand, in the fruitfly *Drosophila*, there is relatively little difference in selection against duplicates of early and late developmental genes[9].