THE FORMATIVE ROLE OF ANCIENT TEXTS

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Imagine an ancient text, a special text, handed down from generation to generation. The origins of the text are unknown, obscured by the mists of time. The text is a source of vital information and wisdom to all those who read it and helps to shape their society - their moment by moment interactions with each other, the decisions they make, and the social institutions they create. Everyone in this society has a copy of the text and looks after it with care. Some sections of the text are detailed and prescriptive, while others may appear ambiguous or conflicting. There are duplications within the text, each time with differences, so choices have to be made with regard to which passages are read and how they should be interpreted - most individuals will not have the time or motivation to read the whole text. All those who share the text live together in meaningful collaboration, moderating their personal wants so that they can contribute to the common good. Their commitment to others is so great that they are prepared, if required, to sacrifice their lives for them; such is the power of the text. No one is allowed to change the text, not even a single letter, but individuals are allowed to add annotations to it in the light of their experience. These annotations are then passed on to their offspring with an exact copy of the text, and the annotations will influence which passages of the text the offspring access. In this way, the traditions associated with particular ways of life are passed on and reinforced through the generations. So even though everyone in this society shares the same text, there can, at the personal level, be many different outcomes. All those who have this text, and live by it, belong. All those without this text - even if they have another by which they live - do not belong, and are outsiders.

Formative texts

The foregoing passage appears to be generalising about the role of an ancient text in shaping human society. Hard-won social wisdom has been passed down to us in these texts and we interpret them and re-interpret them according to our current context and needs. However, when we wrote this passage we were actually thinking about what it might be like to be a cell and the relationship that cells might have with their DNA. If you read the passage again, substituting 'DNA' or 'genome' for the word 'text' and 'cell' for 'individual' then this becomes clearer. The 'annotations' mentioned above refer to epigenetic modifications made to the DNA and associated histones as cells differentiate. Self-sacrifice is included because some cells take their own lives to enable normal tissue functioning and normal embryonic development.

Expressed in this way, there seem to be parallels between the formative role of the genome within a cellular society and the role of an ancient text or a sacred text within a human society. This idea emerged while we were working on a book about development before birth *(Dryden and Arkeveld, 2015).* We were trying to imagine what it would be like to be a cell within a developing embryo or foetus and the social interactions that the cell would experience. Most embryology books and papers are written from the vantage point of an observer looking in from the outside, whereas we were attempting to portray the view from the inside looking out. To make it easier for the reader to take that imaginary leap we decided to represent embryonic cells as people. Our reason for this was to free ourselves from the prevailing scientific idea that the embryo is simply a molecular machine playing out a precise developmental program stored in the genome, and try to imagine instead how embryonic cells decide what to do next within their social context.

We do not believe that the prevailing gene-centric and mechanistic view of the embryo is adequate as an explanation of development. The short-coming becomes particularly evident when considering the behaviour of embryonic cells that are coping with developmental errors - they appear to react in adaptive ways. This suggests to us that prenatal development can be better understood as an unfolding social strategy rather than the running of a predetermined program. Furthermore, it is our belief that prenatal development makes more sense if we envisage that the individual cells have some sort of 'inner life' and make decisions and choices moment-by-moment, influenced by their personal histories up to that time and their on-going interactions with surrounding cells in addition to direct genetic input.

Adaptable cells

To give just one example, in the early embryo there is a thickened layer of cells called the neural plate which will go on to form the brain and most of the spinal cord. The neural plate is initially quite flat, and then it begins to buckle, forming a groove along the midline of the embryo. The groove deepens, and the ridge on each side of the groove rises up. These two neural folds approach each other, and eventually the cells forming the tips of the folds - the neural crest cells - come together and close the roof of what is now the neural tube. This process of closure begins near the middle of the neural plate and then extends forwards and backwards from this region. As closure is attained, some of the neural crest cells disengage from the tube and migrate away into the embryo where they will take on a wide variety of new tasks. However, sometimes this process of closure of the neural tube goes wrong, and the neural folds fail to meet in some portion of the developing tube *(Figure 1).* In the affected region, the neural crest cells may respond by dividing to form tumour-like masses that in some cases become large enough to bridge the gap and achieve closure by this different process, albeit in what looks like a rather disorganised way.

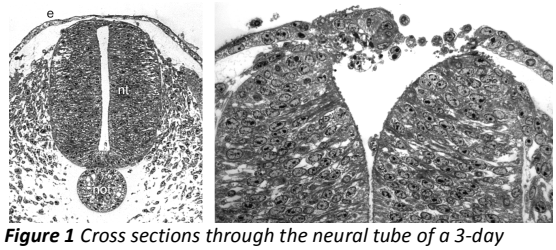

Figure 1 *Cross sections through the neural tube of a 3-day chick embryo in which most of the neural tube has formed normally but in which there is localised non-closure in the mid-somite region.*
left: In this section, the neural tube (nt) is closed and the ectoderm (e) forms a continuous epithelium across the top. The notochord (not) is a rod-like aggregation of cells below the neural tube.
right: section through a more caudal region of the same embryo where the neural folds have not met correctly. Cells mainly from the crest of the neural fold on the left are forming a disorganised mass that is partially closing the deficit in the roof of the neural tube.

The neural crest cells have behaved in quite a different way from usual, and appear to be making the best of an unusual situation. If we accept the premise that development is controlled by a strict genetic program, then we would have to explain an adaptive response like this by proposing that there is a subroutine present in the genome that is there just in case this part of development goes wrong. This would place a significant additional burden on the genome as a repository of developmental information because many things can go wrong during development and embryonic cells show a wide range of adaptive behaviours.

On the other hand, if we go along with the suggestion that is being made here that a key role of DNA is to provide embryonic cells with relevant social skills in addition to prescriptive information, then adaptive behaviours become easier to interpret. We are familiar with the human capacity to react in extraordinary circumstances such as an accident or an emergency - the exact response is not preformulated and predetermined, but can arise from a set of social skills that is robust enough to result in a useful outcome.

Of course, a vague set of social guidelines provided at the outset of development would not be able to achieve the incredible fidelity of

the process of biological development in which offspring not only conform to species specifications but also show family resemblances at a very fine level of detail. However, we are suggesting that we move away from the narrow current conception of molecular mechanisms set up and controlled by genes towards a more realistic account in which individual cells have a greater role in deciding what they do next on the basis of their total experience. Therefore we envisage the embryonic cells living together within networks of social interaction and forming communities which became increasingly adapted and specialised for particular roles. The genome would still have a central role but it would be as much a socially-enabling one as a prescriptive one.

Much of the information in the genome is of ancient canonical origin. For example, long ago in evolutionary time, free-living microorganisms combined symbiotically to form eukaryotic cells and shared their genetic stores *(see for example Margulis and Sagan, 1995).* The information is carefully preserved and copied and passed on from generation to generation of organisms, with a degree of meiotic reshuffling occurring during gamete preparation and the combination of genetic material from different individuals during sexual reproduction. Mutations, copying errors, viral insertions, and natural selection have all changed and channelled the information in genomes over time, but we can still identify a remarkable underlying stability. Some of our own genes can be traced back to those present in the earliest forms of life on this planet. Within each organism, the genome established at the time of fertilisation is carefully copied and passed on to new generations of cells. Different annotations may be added to the DNA by each cell lineage as they differentiate, but all the cells that share the same genome live together cooperatively. These features of DNA - ancient origin, careful maintenance, faithful copying, and unification of the group who shares it - reminded us of the role of certain ancient texts, particularly sacred texts, in the human context.

Ancient and sacred texts

For a society to work, the individuals need to be able to recognise and accept the other members and be prepared to conform to society's expectations and rules. A complex society cannot be fully understood by any single member, so there have to be mechanisms in place to sustain coherence between all the specialised activities taking place. One way of ensuring this, and maintaining continuity through the generations, is to have a written record of what works to provide a thread of stability and continuity that can be played out against the ever-changing environment. This is achieved in living organisms by way of stores of genetic information, and in human societies by way of ancient texts and laws and statutes.

In the human context, ancient texts contain creation stories, mythologies, anecdotes, rules by which to live, history, proverbs, and love poems - in short, they bring together cultural wisdom gained over many previous generations. Often we cannot be sure how the texts first came into being, but some appear to be distillations of earlier oral traditions. Some texts are believed by some to have a divine origin, in which case they believe that the wisdom is revealed or inspired by a supernatural deity. These sacred texts provide the foundations for the world's religions *(for an excellent overview see Smith, 2009)*.Sacred texts can be copied, interpreted, translated, and annotated, but not otherwise changed, rather like the information in DNA. A religion shared by most members of a society can have a significant role in shaping that society, and will influence moral, ethical, legal, economic, political, artistic, philosophical, and educational systems. Belief in an overseeing and judgemental god adds authority to any commands the text might contain about behaving in more socially acceptable ways, with the natural human drives for pleasure and success being played down and replaced with a sense of duty towards one's group. This sense of commitment may even extend to self-sacrifice. In return, a shared religion gives a sense of belonging and cooperation and

security. However, others who do not share the same beliefs are seen as outsiders.
Just as members of a religion have a sense of belonging, a shared genome can give the cells of an organism a sense of self and non-self. Each organism invests heavily in maintaining this distinction, with specialised cells forming an immune system on the lookout for cells or other materials that do not belong.
To have a lasting worth and influence, an ancient or sacred text needs to be relevant to a very wide range of contemporary human situations. It may offer a vision of our place in the greater whole and answers to universal but rationally unanswerable questions such as why we are here and what happens to us after death. It does not need to be a utopian plan for a perfect society but benefits from the inclusion of effective social rules for living together. Although each text has a different origin and differences in content, there are some elements that are widely shared. The so-called 'golden rule' for living in a society that can be paraphrased as "do unto others as you would have them do unto you" occurs in many ancient texts.

The reader

An ancient text or sacred text needs competent human readers if it is to have any social consequences. Each reader must have an inner life sufficient to search for meaning in the text and then make choices on the basis of that meaning and carry out actions. This requires a belief system that ties together memories of previous events, on-going interactions with others, and imagined futures in a meaningful narrative.
There are different ways of reading a text. For example, it can be read literally by interpreting the words at face value. Alternatively, the reader may look for symbolic meanings hidden within the text. Sometimes, a mystical interpretation may be sought, particularly within sections that are ambiguous or conflicting. There can be no definitive interpretation of an ancient or sacred text because it is interpreted through the cultural filters of the time, and for each generation these are likely to be different from those existing in the time and place of the text's origin. A capable text is re-vitalised by this process of re-interpretation and can continue to be a source of wisdom and innovation through the generations. Many readers will not have time to read the text in full, and will sample those parts that are most relevant to them at a given time, perhaps guided by others who have a deeper knowledge of it.
With regard to cells, we do not know whether they also have some sort of inner life, appropriate to cells, but our observations of embryos suggests that they might. Also, we do not know whether the genome can be interpreted in anything other than a literal way by the cell. At the very least, each cell as a whole has to be a competent reader of its genome. In the same way that we have no objective test for consciousness in other people or life-forms, we cannot be sure whether or not a cell has some level of consciousness. However, rather than dismissing the possibility because there is a lack of direct evidence, it seems to us better to assume some level of cellular consciousness until evidence to the contrary is obtained. We know from research that embryonic cells have a sense of their position within the whole embryo *(see for example Kerszberg and Wolpert, 2007)*, and their behaviour also strongly suggests to us that they are capable of decision-making, and are not simply following a deterministic program provided by the genome. We are not suggesting that cells are conscious in the way we are, or that they have a belief system like ours or a belief in the supernatural, rather that they have at least some experience of being part of a social network, a sense of place and belonging, and the ability to model and decide what to do next according to circumstances and genetic guidance.

Cellular societies and human societies

We are familiar with living in communities and nations, and we have direct experience of having to balance our personal wishes and ambitions against society's expectations of us. We experience change within our community

over time as new structures and institutions emerge in response to social needs and innovation, all without the need for a master plan at the beginning. Change can be driven by imaginative problem-solving in the absence of preceding solutions. As we grow and develop after birth, our belief system takes the form of a working hypothesis about the world and our place within it. We search for patterns and meaning in the deluge of information we receive, and look for cause and effect relationships. These conjectures are then put to the test by future events, and if the consequences of our actions turn out to be different from what we expected then we have to re-examine our beliefs and perhaps change them. Our ability to model possibilities on the basis of memory and incoming information means that our actions can be innovative. We propose that this experience of living in a complex, changing society can give us a useful insight into how cells live together and build embryos.

Figure 2 *Embryonic cells imagined as people - here they are working together during morphogenesis of the neural tube.*

Detail from a drawing by Hans Arkeveld (Dryden and Arkeveld, 2015).

So the suggestion is being made here that there are parallels between the role of DNA in developing organisms and the role of ancient and sacred texts in human societies. We envisage that each provides a strategy that guides individuals, either cells or people, and enables them to live together cooperatively and create complex societies. Genomes and texts are agents of formative change. At this stage, the hypothesis is not a scientific one and has not been put to the test, but it may help us in two ways. Firstly, it may move us away from an overly-simplistic view of embryos as molecular entities blindly following a detailed and deterministic genetic program, and secondly it may allow us to see that ancient and sacred texts, and the religions based on them, have not simply "come out of nowhere" as a uniquely human creation. Genomes and sacred texts are repositories of ancient and practical knowledge that can accelerate social development, each time being interpreted anew within their changed settings. This is an effective way of enabling societies to form and develop.

References

Dryden, R. and Arkeveld, H. (2015) **A Smaller I - Reflections of a fetal cell.**Minard: Rufus-Pi Imprint. (ISBN 978-0-9929599-0-6, available from www.lulu.com)

Kerszberg, M. and Wolpert, L. (2007) Specifying positional information in the embryo: looking beyond morphogens.*Cell*, **130**: 205-209.

Margulis, L. and Sagan, D. (1995)**What is life?** London: Wiedenfeld and Nicolson.

Smith, H. (2009) **The world's religions**. New York: HarperCollins Publishers.

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