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Science and Ethics (and Sustainability): relevance to the IB
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It is commonly believed that science can only deal with facts, and that 'values' are off limits to the scientific method. I don't agree with that, and I will address the question: "What does modern science have to say about the values of internationalism and tolerance held by the IB community?"

My principal qualification here is that I am a practicing scientist, and that I maintain an active interest in various disciplines outside of my own – marine biology and fisheries science – notably in human evolutionary history and related fields, in linguistics and in the philosophy of science. I am also the proud father of an IB graduate, and the husband of an IBO staff member, Sandra Pauly, who has taught me about the IB philosophy, and has invited me to give occasional presentations to TOK classes.

We shall start with a few numbers that are largely accepted by the wider scientific community.

The species to which we all belong, *Homo sapiens* is relatively recent, and evolved out of a local population of *Homo erectus*, somewhere in North East Africa, some 150, 000 years ago.

The migration of *Homo sapiens* out of Africa occurred about 70, 000 year ago, and involved less than 1000 members of a population of about 20,000 persons in total. All non-African humans alive today (all Asian, European, Australians, Aboriginals, Pacific islanders, Amerindians...) are the descendents of these few migrants. These emigrants took with them the language spoken by the larger population from which they were drawn. Some of the features of that first language, which diversified into the 6000 languages now spoken, may have been identified.

These facts are known from a remarkable convergence of results from Archaeology, Genetics, Linguistics and other disciplines, which continue to refine these estimates and provide more details, e.g., in the pages of the magazines *Science* and *Nature*.

This has numerous implications for IB values, notably because it is not propaganda, but literally true that all humans on Earth are closely related, and that genetic differences between groups of humans ('races', 'ethnic groups') are bound to be small (there was simply not enough time for large differences to emerge).

Until the 1980s, when the picture presented above began to emerge, it was still fashionable to postulate a dichotomy between 'nature' and 'culture', with culture as the repository of our ethical values, while nature was hidden in the attic, like we would a raving mad uncle.

Modern research in genetics and evolutionary theory has confirmed the view that our human body are constructs of our genes, and that these pursue 'selfish' aims (replication) when they encourage us, via our emotions, to make certain choices. But these aims are, for obvious reasons, also compatible with our culture.

Take for example 'beauty' (e.g., of the female face), the motif of so much art, and the best example of something thought previously not to be amenable to scientific inquiry - "Beauty is in the Eyes of the Beholder". Beauty was thought to be a reflection of some divine harmony (as in 'divine numbers'), but this was not an explanation. (I will explain why not further below).

Mad scientist Francis Galton (Charles Darwin's cousin), the founder of eugenics, once attempted to obtain a criminal 'archetype' by superimposing photos of (plain looking) 'criminal' women. The average face he got, however, was beautiful, and, being the prejudiced person he was, he left his research in disgust. Similar experiments were conducted again in the 1990s, and they always turned out the same: the more faces were averaged, the more beautiful the resulting faces. The same thing was found in animals, notably insects and fish: average features imply higher fitness (larger number of descendants). This is known in Evolutionary Biology as 'stabilizing selection', and it occurs because the future cannot be predicted reliably. Thus, choosing a mate with a mix of average features is your best bet for the future. This obviously applies to other features, not only the face (and yes, it is a bit more complicated in reality). But still, we can draw an important conclusion: we are genetically programmed to seek and appreciate 'beauty', but we visually 'sample' from the people we see the features used to determine who will be found beautiful and this can vary between ethnic groups. And yes, globalization (e.g., of images) has made beauty standard in humans increasingly global, to the great delight and benefit of international modeling agencies.

Another puzzle of human evolutionary biology is the existence of altruism or the performing of good deeds, for which religion usually, and generally unjustifiably, takes credit. Evil does not seem to require explaining, by the way, because selfish individuals, or selfish genes, seem to provide all explanation one needs. If we, however, act ultimately on behalf of our genes, we need not only to be altruistic vis-à-vis our children (with whom we share $\frac{1}{2}$ of our genes), but also our siblings (also $\frac{1}{2}$), our cousins ($\frac{1}{4}$), and all our other relatives. Indeed, in the small groups typical for most of our evolution, we will have shared genes with almost everybody, and thus had good genetic reasons to act altruistically.

Thus, while incessant conflict between groups was most probably the norm for our ancestors, an extremely high level of within-group altruism also prevailed, and that could have extended to 'adopted' strangers, and later extended the in-group further ('Tribe', 'Nation', etc). Indeed, all we need, nowadays, is to extend in-group altruism to the whole of humanity. Thus, there is a good scientific basis for the IB's promotion of altruistic values.

I have provided what I call an 'explanation' for our perception of beauty and for altruism, but not defined what I mean by 'explanation', or 'why' and 'how', which is more or less equivalent, and which IB students are bound to ask.

When is an explanation reasonable (or sufficient)? In Science, the explanation for a suite of facts (observation, measurements, etc) is sufficient when it can make sense of all of them while referring back to a cause that is simpler than the facts that are to be explained. Moreover, this cause must itself part of the body of previously accepted facts of another, more basic discipline.

Thus, psychological ('beauty') or social ('altruism') phenomena can be explained by Evolutionary Biology, and physiological phenomena (e.g., vision) can be explained with reference to chemistry and physics, but none of these phenomena can be explained by theology or philosophy. This mutual compatibility of the facts of different scientific disciplines, the 'jumping together' is known as consilience, and it is a major feature of modern science.

Thus, TOK as taught in some IB classes emphasizes far too much the uncertain, temporary, even subjective aspects of science, using the texts of Karl Popper and Thomas Kuhn. These authors dealt, in their examples, mainly with physics, and within that discipline, with the replacement of Newtonian physics by Einstein's General Relativity. The theories involved here define the nature of the space within which our universe unfolds, and it is obvious that humans were not going to get that right for a long time.

In the other disciplines, however, progress has been far more cumulative, and usually, new insights do not simply replace old ones, but complement them or redefine their area of application (or validity). For IB/TOK, this probably means putting E.O. Wilson's 'Consilience' on the curriculum, rather than Karl Popper, Thomas Kuhn and Co.

The preceding was to show that modern science is compatible with universal values of tolerance (based on our equality as member of the same species) and altruism (as the 'social glue' of all human societies).

Thus, science is available for an extension of the Enlightenment, a 200-year-old project that has been much criticized lately, but to which there is simply no alternative – or no alternative that sane people might wish to contemplate. However, there is a snag, and that's the issue of sustainability. Voltaire, for example, had to deal with the claims of absolute kings and entrenched religious authorities, but he did not have to deal with the survival of humankind on this planet. We do.

My professional lectures are usually devoted to the way fisheries are destroying life in the ocean. I don't want to deal with this here. The big problem we face is global warming – and let's not discuss whether this is happening right now, because if it is not, it will soon, given our greenhouse gas emissions. Our industrial infrastructure, our transport system, our housing, our daily habits, need changing really fast if we are to overcome this crisis, and not be overcome by it. The ultimate unethical act, the ultimate genocide would be to make this planet inhabitable to humans. For the IB, this means that sustainability in general, and global warming in particular, must be part of the curriculum.

This should not be an issue for witty debates, but as an issue to address, one that will determine whether that species that emerged 150, 000 years ago will continue to thrive on this planet, and play music and write poems.

Further Reading:

- Cavalli-Sforza, L. 2000. *Genes, peoples, and languages*. Farrar, Straus & Giroux, New York, 228 p.
- Gore, A. 2006. *An Inconvenient Truth: The Planetary Emergency of Global Warming and What We Can Do About It*. Bloomsbury Publishing, New York, 336 p.
- Singer, P. 2000. *A Darwinian left: Politics, Evolution, and Cooperation*. Yale University Press, New Haven, 70 p.
- Well, S. 2002. *The Journey of Man: a Genetic Odyssey*. Princeton University Press, Princeton, 224 p.
- Wilson, E.O. 1998. *Consilience: The Unity of Knowledge*. Alfred A. Knopf, New York, 322 p.

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