The evolutionary future of man - A biological view of progress

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EVOLUTION is widely regarded as a progressive force thrusting inexorably towards racial improvement, which may be seen as offering some tangible hope for our troubled species. Unfortunately this way of thinking is based on two misunderstandings. First, it is by no means clear that evolution is necessarily progressive. Second, even when it is progressive, significant change proceeds on a time-scale many orders of magnitude longer than the scale of tens or hundreds of years with which historians feel at home.

We can define evolutionary progress either in a value-laden or a value-neutral way--ie, either with or without building in notions of what is good or bad. A value-laden definition specifies whether the factor being monitored, be it brain-size, intelligence, artistic ability, physical strength or whatever, is desirable or undesirable. If a desirable factor increases, that is progress. But on a value-neutral definition, any change at all counts as progress, just so long as it continues on its course. Such a definition simply takes three entities in a time sequence--think of them as a series of ancestral fossils and call them Early, Middle and Late- -and asks whether the change from Early to Middle is in the same direction as the change from Middle to Late. If the answer is yes, that is a progressive change. This definition is value-neutral because the factor which we discover to be "progressive" could be something which we regard as bad--say, idleness or stupidity. In this value-neutral sense, a continued trend towards decreased brain size would be progressive, just as much as a trend towards increased brain size would be. The only thing that would not be progressive would be a reversal of the trend.

It was once fashionable for biologists to believe in something called orthogenesis. This was the theory that trends in evolution constitute a driving force and continue under their own momentum. The Irish Elk was thought to have been driven extinct by its huge antlers, which in turn were thought to have grown bigger under the influence of an orthogenetic force. Perhaps initially there was some advantage in larger antlers and this was how the trend started. But, once started, the trend had its own internal unstoppability, and, as the generations went by, the antlers continued inexorably to grow until they drove the species extinct.

We now think that the theory of orthogenesis is wrong. If a trend is seen towards increasing antler size, this is because natural selection favours larger antlers. Individual stags with large antlers have more offspring than stags with average-sized antlers, either because they survive better (unlikely) or attract females (probably irrelevant) or because they are better at intimidating rivals (likely). If the trend appears to persist for a long time in the fossil record, this indicates that natural selection was pushing in that direction for all that time. Metaphors like "inherent force" and "inexorable momentum" have no validity.

It seems to follow that there is no general reason to expect evolution to be progressive--even in the weak, value-neutral sense. There will be times when increased size of some organ is favoured and other times when decreased size is favoured. Most of the time, average-sized individuals will be favoured in the population and both extremes will be penalised. During these times the population exhibits evolutionary stasis (ie, no change) with respect to the factor being measured. If we had a complete fossil record and looked for trends in some particular dimension, such as leg length, we would expect to see periods of no change alternating with fitful continuations or reversals in direction--like a weathervane in changeable, gusty weather.

It is all the more intriguing to find that sometimes long, progressive trends in one direction do turn up. When an organ is used for intimidation (like a stag's antlers) or for attraction (like the peacock's tail), it may be that the best size to have--from the point of view of intimidation or attraction--is always slightly larger than the average in the population. Even when the average gets bigger, the optimum is always one step ahead. It is possible that such "moving-target selection" did drive the Irish Elk extinct after all: by pushing the "intimidation optimum" too far ahead of what would have

been the overall "utilitarian optimum". Peacocks and male birds of paradise also seem to have been pushed, in this case by female-taste selection, far from the utilitarian optimum of an efficient flying and surviving machine (though they have not been driven over the edge into extinction).

Another force driving progressive evolution is the so-called "arms-race". Prey animals evolve faster running speeds because predators do. Consequently predators have to evolve even faster running speeds, and so on, in an escalating spiral. Such arms races probably account for the spectacularly advanced engineering of eyes, ears, brains, bat "radar" and all the other high-tech weaponry that animals display. Arms races are a special case of "co-evolution". Co-evolution occurs whenever the environment in which creatures evolve is itself evolving. From an antelope's point of view, lions are part of the environment like the weather--with the important difference that lions evolve.

Virtual progress

I want to suggest a new kind of co-evolution which, I believe, may have been responsible for one of the most spectacular examples of progressive evolution: the enlargement of the human brain. At some point in the evolution of brains, they acquired the ability to simulate models of the outside world. In its advanced forms we call this ability "imagination. " It may be compared to the virtual-reality software that runs on some computers. Now here is the point I want to make. The internal "virtual world" in which animals live may in effect become a part of the environment, of comparable importance to the climate, vegetation, predators and so on outside. If so, a co-evolutionary spiral may take off, with hardware--especially brain hardware--evolving to meet improvements in the internal "virtual environment." The changes in hardware then stimulate improvements in the virtual environment, and the spiral continues.

The progressive spiral is likely to advance even faster if the virtual environment is put together as a shared enterprise involving many individuals. And it is likely to reach breakneck speeds if it can accumulate progressively over generations. Language and other aspects of human culture provide a mechanism whereby such accumulation can occur. It may be that brain hardware has co-evolved with the internal virtual worlds that it creates. This can be called hardware-software co-evolution. Language could be both a vehicle of this co-evolution and its most spectacular software product. We know almost nothing of how language originated, since it started to fossilise only very recently, in the form of writing. Hardware has been fossilising for much longer--at least the brain's bony outer casing has. Its steadily increasing size, indicating a corresponding increase in the size of the brain itself, is what I want to turn to next.

It is almost certain that modern Homo sapiens (which dates only from about 100,000 years ago) is descended from a similar species, H. erectus, which first appeared a little before 1.6m years ago. It is thought that H. erectus, in turn, was descended from some form of Australopithecus. A possible candidate which lived about 3m years ago is Australopithecus afarensis, represented by the famous "Lucy." These creatures, which are often described as upright-walking apes, had brains about the size of a chimpanzee's. Figure 1 on the next page shows pictures of the three skulls, in chronological order. Presumably the change from Australopithecus to erectus was gradual. This is not to say that it took 1.5m years to accomplish at a uniform rate. It could easily have occurred in fits and starts. The same goes for the change from erectus to sapiens. By about 300,000 years ago, we start to find fossils that are called "archaic H. sapiens", largish-brained people like ourselves but with heavy brow ridges more like H. erectus.

It looks, in a general way, as though there are some progressive changes running through this series. Our braincase is nearly twice the size of erectus's; and erectus's braincase, in turn, is about twice the size of that of Australopithecus afarensis. This impression is vividly illustrated in the next picture, which was prepared using a program called Morph.*

To use Morph, you supply it with a starting picture and an ending picture, and tell it which points on the starting picture correspond to which opposite-number points on the ending picture. Morph then computes a series of mathematical intermediates between the two pictures. The series may be

viewed as a cine film on the computer screen, but for printing it is necessary to extract a series of still frames--arranged here in order in a spiral (figure 2). The spiral includes two concatenated sequences: Australopithecus to H. erectus and H. erectus to H. sapiens. Conveniently the two time intervals separating these three landmark fossils are approximately the same, about 1.5m years. The three labelled landmark skulls constitute the data supplied to Morph. All the others are the computed intermediates (ignore H. futuris for the moment).

Swirl your eye round the spiral looking for trends. It is broadly true that any trends you find before H. erectus continue after him. The film version shows this much more dramatically, so much so that it is hard, as you watch the film, to detect any discontinuity as you pass through H. erectus. We have made similar films for a number of probable evolutionary transitions in human ancestry. More often than not, trends show reversals of direction. The relatively smooth continuity around H. erectus is quite unusual.

We can say that there has been a long, progressive--and by evolutionary standards very rapid--trend over the past 3m years of human skull evolution. I am speaking of progress in the value-neutral sense here. As it happens, anybody who thinks increased brain size has positive value can also claim this trend as value-laden progress too. This is because the dominant trend, flowing both before and after H. erectus, is the spectacular ballooning of the brain.

What of the future? Can we extrapolate the trend from H. erectus through and beyond H. sapiens, and predict the skull shape of H. futuris 3m years hence? Only an orthogeneticist would take it seriously; but, for what it is worth, we have made an extrapolation with the aid of Morph, and it is appended at the end of the spiral diagram. It shows a continuation of the trend to inflate the balloon of the braincase; the chin continues to move forward and sharpen into a silly little goatee point, while the jaw itself looks too small to chew anything but baby pap. Indeed the whole cranium is quite reminiscent of a baby's skull. It was long ago suggested that human evolution is an example of "paedomorphosis": the retention of juvenile characteristics into adulthood. The adult human skull looks more like a baby chimp's than like an adult chimp's.

Don't bank on H. futuris

Is there any likelihood that something like this hypothetical large- brained H. futuris will evolve? I'd put very little money on it, one way or the other. Certainly the mere fact that brain inflation has been the dominant trend over the past 3m years says almost nothing about probable trends in the next 3m. Brains will continue to inflate only if natural selection continues to favour large-brained individuals. This means, when you come down to it, if large-brained individuals manage to have, on average, more children than small-brained ones.

It is not unreasonable to assume that large brains go with intelligence, and that intelligence, in our wild ancestors, was associated with ability to survive, ability to attract mates or ability to outwit rivals. Not unreasonable--but both these clauses would find their critics. It is an article of passionate faith among "politically correct" biologists and anthropologists that brain size has no connection with intelligence; that intelligence has nothing to do with genes; and that genes are probably nasty fascist things anyway.

Leaving this to one side, problems with the idea remain. In the days when most individuals died young, the main qualification for reproduction was survival into adulthood. But in our western civilisation few die young, most adults choose to have fewer children than they are physically and economically capable of, and it is by no means clear that people with the largest families are the most intelligent. Anybody viewing future human evolution from the perspective of advanced western civilisation is unlikely to make confident predictions about brain size continuing to evolve.

In any case, all these ways of viewing the matter are far too short- term. Socially important phenomena such as contraception and education exert their influences over the timescale of human historians, over decades and centuries. Evolutionary trends--at least those that last long

enough to deserve the title progressive--are so slow that they are all but totally insensitive to the vagaries of social and historical time. If we could assume that something like our advanced scientific civilisation was going to last for 1m, or even 100,000, years, it might be worth thinking about the undercurrents of natural-selection pressure in these civilised conditions. But the likelihood is that, in 100,000 years time, we shall either have reverted to wild barbarism, or else civilisation will have advanced beyond all recognition--into colonies in outer space, for instance. In either case, evolutionary extrapolations from present conditions are likely to be highly misleading.

Evolutionists are usually pretty coy about predicting the future. Our species is a particularly hard one to predict because human culture, at least for the past few thousand years and speeding up all the time, changes in ways that mimic evolutionary change, only thousands to hundreds of thousands of times faster. This is most clearly seen when we look at technical hardware. It is almost a cliche to point out that the wheeled vehicle, the aeroplane, and the electronic computer, to say nothing of more frivolous examples such as dress fashions, evolve in ways strikingly reminiscent of biological evolution. My formal definitions of value- laden and value-neutral progress, although designed for fossil bones, can be applied, without modification, to cultural and technological trends.

Prevailing skirt and hair lengths in western society are progressive--value-neutrally, because they are too trivial to be anything else--for short periods if at all. Viewed over the timescale of decades, the average lengths fritter up and down like yo-yos. Weapons improve (at what they are designed to do, which may be of positive or negative value depending on your point of view) consistently and progressively, at least partly to counter improvements in the weaponry of enemies. But mostly, like any other technology, they improve because new inventions build on earlier ones and inventors in any age benefit from the ideas, efforts and experience of their predecessors. This principle is most spectacularly demonstrated by the evolution of the digital computer. The late Christopher Evans, a psychologist and author, calculated that if the motor car had evolved as fast as the computer, and over the same time period, "Today you would be able to buy a Rolls-Royce for ?.35, it would do three million miles to the gallon, and it would deliver enough power to drive the QE2. And if you were interested in miniaturisation, you could place half a dozen of them on a pinhead."

Science and the technology that it inspires can, of course, be used for backward ends. Continued trends in, say, aeroplane or computer speed, are undoubtedly progressive in a value-neutral sense. It would be easy to see them also as progressive in various value-laden senses. But such progress could also turn out to be laden with deeply negative value if the technologies fall into the hands of, say, religious fundamentalists bent on the destruction of rival sects who face a different point of the compass in order to pray, or some equally insufferable habit. Much may depend on whether the societies with the scientific know-how and the civilised values necessary to develop the technologies keep control of them; or whether they allow them to spread to educationally and scientifically backward societies which happen to have the money to buy them.

Scientific and technological progress themselves are value-neutral. They are just very good at doing what they do. If you want to do selfish, greedy, intolerant and violent things, scientific technology will provide you with by far the most efficient way of doing so. But if you want to do good, to solve the world's problems, to progress in the best value-laden sense, once again, there is no better means to those ends than the scientific way. For good or ill, I expect scientific knowledge and technical invention to develop progressively over the next 150 years, and at an accelerating rate.