Tropical forest biochemistry, the driving force in human evolution.

The evolution of the large human brain remains one of biology's greatest unsolved mysteries. Primates generally have a relatively large brain to body ratio, apes, the extinct hominids and particularly humans have taken this trait to extreme. No theory to date has come close to explaining this phenomena.

Some of the key elements

The relatively large brain to body ratio exhibited by primates generally

The continued expansion of the brain from apes through the extinct hominids to humans.

The rapid and accelerating expansion of the brain in the later phase of human evolution.

The abrupt stall in neural expansion c 200,000 years ago and the subsequent shrinkage.

Associated traits that have also proved difficult to explain, i.e. retention of juvenile characteristics, fertility/menstruation, nakedness, gut morphology, fuel hungry brain, dentation etc.

Attempts to explain the large brain and other unusual traits have centred on adaptive selection i.e. identifying environmental/social pressures that may have led to such unusual physiological adaptations.

The savannah was virtually accepted as the environment that must have driven these traits though it could not account for what was already a significant mystery i.e. the relatively large ape brain that had already evolved in the forest. However without solving that unique problem a totally new one was invented, how to explain the extra large brain of the hominids. That two such clearly related and unusual phenomena would have two utterly distinct causes seems unlikely.
The savannah model has in recent times been significantly discounted, subsequent pollen analysis at famous 'savannah' hominid fossil sites has clearly indicated that the habitats were wooded or forested. In addition Dr Michael Crawford a biochemist from the Institute of Brain Chemistry and Human Nutrition at the University of North London has pointed out that there are insufficient fatty acids (specifically DHA, the brain is composed of 80% DHA) available on the savannah to grow a large brain.

Dr Crawford and others support a coastal dwelling scenario whereby human ancestors moved from the forest to live by the coast as this environment provides an abundant supply of DHA. The implication being that the expansion of the brain was limited by the lack of a ready supply of DHA or the rate the body can convert omega 3 fatty acids to DHA and simply providing a ready source was all that was required to induce rapid expansion.
In recent correspondence with Dr Crawford I pointed out that an ape can grow a c200 cubic centimetre brain in around 8 months primarily by converting omega 3 fatty acids available in a forest diet to DHA. By simply extending the rapid growth

windows a much larger brain is feasible via omega 3 conversion without recourse to additional ready made DHA. Human brain growth occurs over a much longer period than apes. Longer gestation and a very significant period of postnatal brain growth is a unique feature of human development. Breast milk contains significant amounts of DHA depending on the fatty acid composition of the diet being eaten and can be drawn from reserves laid down before pregnancy. Extending the breastfeeding period may have been an essential part of the neural expansion formula ironing out the high demand for DHA during early development.

Another contender is the aquatic ape theory, it suggests many human traits could be explained by a long period of living in a semi-aquatic environment. No mechanism is proposed to explain how the association was responsible for producing such a large brain.

The reality is that no coherent model exists and there is no consensus to explain the unique features of the primate brain particularly the apes, extinct hominids and humans.

Perhaps it is reasonable to consider that evolution of such rare traits may have required a novel mechanism to produce them. Genetic mutation and selective adaptation seems to account very well for virtually all traits in all organisms. In the case of primate/human evolution a subtle variation may have been at work alongside classic selection.

One well known anthropologist, Dr Colin Groves has suggested that the large brain may be a fortuitous consequence of neoteny (retention of juvenile features). This contradicts previous ideas where neoteny has been presumed to be a consequence of the expanding brain. In recent correspondence he stands by his proposal though he has not proposed a mechanism to account for this.

A common factor central to juvenility and brain development is our own endocrine system and the hormones it produces, particularly the sex steroids. They play a major role in governing windows of development and directly influence the structural development of the brain. In addition steroids are directly involved in the transcription of DNA, they are part of the reading mechanism dictating how the code is translated into bio-chemical structure. Anything that alters the action of steroids will inevitably alter all of the above.

I have proposed that the powerful steroid modulating chemicals that are abundant in a typical primate diet were responsible for modifying the growth and development of the brain and the window that such growth and development occurs.
The chemicals in question are particularly rich in fruit and flowers and typically inhibit the activity of sex steroids such as testosterone and estrogens. In addition they have mild to moderate neuroactive properties (Monoamine oxidase inhibitors).

Flavonoids are increasingly the subject of research in part because they demonstrate such powerful endocrine altering properties.

Any animal consuming these chemicals in quantity will be affected.

A tropical forest environment has the capacity to provide these chemicals 24/7 for evolutionary time scales.
In effect eating a diet rich in fruit/flowers significantly alters your endocrine system. This creates a blanket effect, all aspects of growth development and physiology will be modified though any part of the physiology that is particularly steroid sensitive will exhibit the most significant response i.e. developmental windows, developing neural tissue, fertility cycles etc.

This almost certainly happened when proto-primates began to eat flowers and then fruit as well as leaves etc. The potential to extend the juvenile phase by inhibiting sex steroids and in turn allow a longer period of brain growth is perhaps the most obvious effect.

These effects have never been considered in an evolutionary context. Rather than trying to explain brain expansion from an adaptive perspective in regard to single traits it becomes possible to see the brain and other features as a fortuitous by product of a biochemically modified endocrine system.

(I have proposed one further step in regard to hominid/human evolution. Given sufficient variation in the effects of flavonoids on the developing neuroendocrine system it seems plausible that in some instances the modified endocrine system itself begins to add a layer of steroid inhibition. For example, elevating the activity of the pineal gland produces more melatonin and pinoline, both powerful steroid inhibitors. In such a scenario the scene is set for a classic runaway feedback loop, more steroid inhibition further expansion of the brain and modification of the endocrine system equals more blanket steroid inhibition etc. As these effects are not locked into the DNA in an adaptive sense they are potentially unstable, lose any part of the positive feedback loop i.e. the tropical forest flavonoids and it will stall. There is some evidence for such a scenario.)

There are undoubtedly a number of variables to consider

The genetic predisposition/sensitivity of any given primate lineage.
The variable % of fruit/flowers in a given dietary specialisation.
The variable outcome in any combination of above.

While these and other factors need to be considered the overall effect of these plant chemicals is not in doubt. Their power is sufficient that detrimental as well as beneficial effects may well have initially occurred. However it is entirely plausible that any primates that significantly specialised in fruit/flowers would exhibit the greatest effects.

The question that needs to be addressed now is how can our neuroendocrine system possibly function without a complex cocktail of powerful steroid modifying chemicals that were permanently present during 70 million years of evolution?

Aside from proposing that plant chemicals initiated and drove the structural/functional evolution of our brain I have also proposed that the loss of these chemicals left our

uninhibited endocrine system unable to provide an appropriate hormonal environment for our brain to develop. Once our connection with the forest was lost our brain stopped expanding and now fails to develop it full function.

Due to archaic specialisation between the cerebral hemispheres I have proposed that the effects of the loss of these chemicals is lateralised one side being more affected than the other. Cerebral dominance and handedness etc are symptoms of this condition.
Significant evidence is emerging to support this scenario, Professor Alan Snyder (Director, Centre for the Mind, Australia) Dr Darold Treffert (University of Wisconsin Medical School) and Professor Vilayanur Ramachandran (Director of the Centre for Brain and Cognition) amongst others have increasingly highlighted a somewhat perplexing scenario. The dominant side of our brain is considerably less functional than the non-dominant side, the emerging data is still considered within the framework of adaptive selection i.e. there must be an evolutionary reason for the phenomena.

Shamanic techniques (i.e. sleep deprivation) and ethnobotanical use of plant chemicals were an attempt to address the emerging condition. For example the widespread use of plant DMT combined with MAO inhibitors was simply a crude attempt to ameliorate a progressive reduction in the production of neural DMT and pinoline in the brain. These and other deficiencies emerged as the human neuro-endocrine system struggled to function normally once the plant hormones were lost.

Summary

Flavonoids are **extremely** potent endocrine modulators.

They were an integral part of our endocrine system for tens of millions of years, their impact on our general health is only just beginning to be researched. Their effects on growth and development in an evolutionary perspective have not been considered.

Flavonoids powerfully inhibit the activity of steroids

Flavonoids powerfully inhibit the conversion of steroids (androgens to estrogens)

Flavonoids inhibit monoamine oxidase increasing pineal production of melatonin

Melatonin powerfully inhibits the activity of steroids.

Steroids are central in all aspects of development growth and function. Neural development in the uterus is particularly sensitive to steroid activity as are steroid governed developmental windows i.e. puberty.

An increasingly specialised fruit diet rich in flavonoids would it seems explain many of the mysteries surrounding human evolution. The gross nutritional aspects are of some relevance i.e. larger fuel hungry brain requiring an ever-greater quantity of simple sugars, however it is the hormonal effects that have thus far been ignored.

Once equipped with an increasingly large brain and the intelligence it conveys it is feasible to survive in a range of hostile habitats. No doubt repeated waves of forest migrants did just that and survived and adapted as distinct species on the savannah or in temperate climates. The orthodox assumption is that the expansion of the brain must have been driven by selective adaptation in relatively hostile or challenging environments. Is there any evidence that the brain continued to expand in these environments or was it the relatively benign tropical forest and its complex hormone modifying biochemistry that played an essential part in the brain expansion formula?