Some bugs do grow bigger with higher oxygen

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Most modern creation organisations, CMI among them, are aware of the substantial problems, both biblical and scientific, with the 'pre-Flood vapour canopy' model.[1]

One argument used to support that notion was the contention that atmospheric oxygen partial pressure[2] had to be higher in the past, in order for giant insects to have been able to breathe. (The weight of the canopy, by increasing total pressure, would have increased oxygen partial pressure.)

The idea was that since insects had no lungs, but breathed passively through tubes (tracheae) leading to holes on the outside (spiracles), this limited the size they could reach. Thus, the existence of some very large insects in the fossil record was support for the idea that oxygen partial pressure was higher.

Big bugs

For example, *Megaloprepus caerulatus* (figure 1), the largest dragonfly species today, has a wingspan of up to 19 cm and its body is over 12 cm long. By contrast, the extinct *Meganeura* dragonfly found in the fossil record had a wingspan of nearly 90 cm, and its body was up to a metre long.

However, this seemed to crumble when it was discovered that insects don't breathe passively at all,[3] but "pump their air tubes much as humans expand and contract their lungs."[4] This means that a key argument that increased oxygen partial pressure was *necessary* for large insects is shown to be unsound.

But in an interesting twist, researchers have now shown that raising insects in high levels of oxygen affects their size, though very unevenly.[5]

Researcher John VandenBrooks of Arizona State University in Tempe raised insects in various levels of atmospheric oxygen. The *Science Daily* report on this work said: "In all, ten out of twelve kinds of insects studied decreased in size in lower oxygen atmospheres. But there were varied responses when they were placed into an enriched oxygen atmosphere."[2]

Vandenbrooks and his team found that dragonflies raised in higher levels of oxygen grew faster and became bigger adults, though nothing approaching the fossil size. This is consistent with the idea that the pre-Flood atmosphere had higher levels of oxygen. Cockroaches, on the other hand, actually grew more slowly, and did not become bigger adults in a hyperoxic environment. While that might superficially seem to negate the idea of higher past O_2 levels, it is actually consistent with it when one considers that cockroaches in the fossil record did not grow much larger than today. The largest cockroach on Earth today is the giant burrowing cockroach (*Macropanesthia rhinoceros*; figure 1), which can attain a length of more than 8 cm. The largest fossil cockroach on record is, at nearly 9 cm, only a little longer.

Why the roaches didn't enlarge

Puzzled by this seemingly contrary situation with cockroaches, the researchers found that the roaches reared in high oxygen reacted by having smaller tracheal tubes. The team theorized that this might allow the insects to "invest more in tissues used for other vital functions other than breathing—like eating or reproducing."

Also, oxygen is a very reactive molecule, and aerobic creatures must have means of dealing with it. Hence the important role of *anti*-oxidants. It is therefore not surprising that too high an oxygen level can be toxic. So is not clear that higher oxygen concentration will be beneficial (see also ref. 1).

What is important to note, however, is that in these experiments, the higher partial pressure of oxygen was achieved not by increasing the total pressure (which is what a canopy might do) but by increasing oxygen *concentration* $[O_2]$.[6]

Quite appropriately, VandenBrooks suggests that the next step would be to examine the tubes in insects found in amber, as a possible indicator of past oxygen levels.

It certainly seems that this would be much more definitive than trying

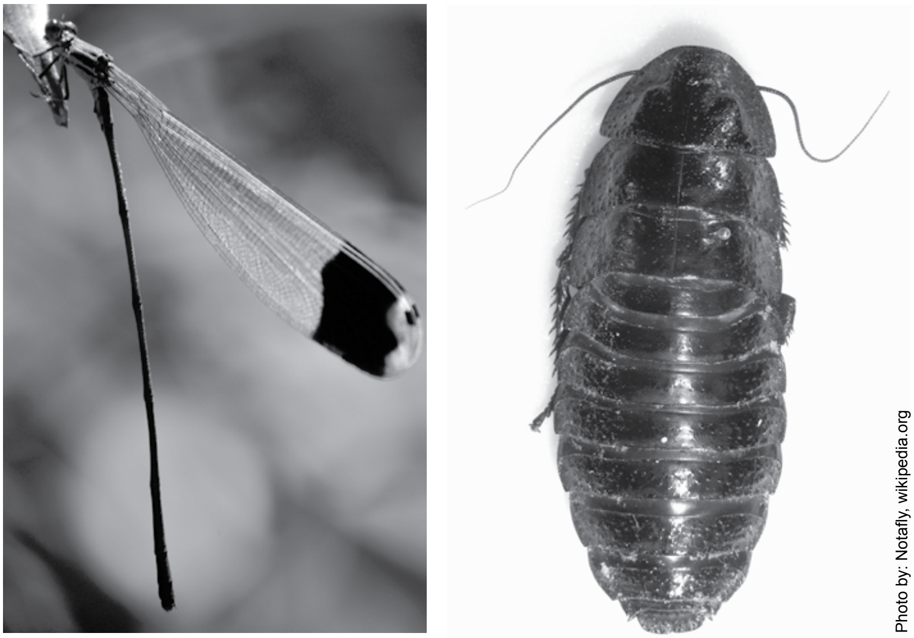

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Figure 1. *Megaloprepus caerulatus*, the largest extant dragonfly species (left) and *Macropanesthia rhinoceros*, the largest extant cockroach species (right).

to judge the preFlood atmosphere O_2 concentration based on analysis of air bubbles trapped in amber. Amber is unlikely to form a seal impervious to gas molecules, and bubbles add to the pressure in any case. Whereas the tracheal tube comparisons could conceivably tell us about the oxygen content in the atmosphere in which the insect actually grew to maturity.

If such future studies suggest that oxygen levels pre-Flood were higher, this may be because the pre-Flood world carried more oxygen-producing vegetation, possibly due to greater land area and 'floating forests', much of it buried during the Flood.[7]

References

1. See also Sarfati, J., Flood models and biblical realism, *J. Creation* **24**(3):46–53, 2010.
2. The partial pressure of a particular gas in a mixture is the pressure it would exert if it occupied the whole volume. Thus the sum of partial pressures of all gases in a mixture equals the total pressure of the gas mixture (Dalton's Law).
3. Westneat, M.W. *et al.*, Tracheal respiration in insects visualized with synchrotron X–ray imaging, *Science* **299**(5606):558–560, 2003 | doi:10.1126/science.1078008.
4. Catchpoole, D., Insect inspiration solves giant bug mystery, *Creation* **27**(4):44–47, 2005; creation.com/giant-bug-mystery.
5. Raising Giant Insects to Unravel Ancient Oxygen, www.sciencedaily.com, 30 October 2010.
6. Partial pressure is directly proportional to concentration.
7. Scheven, J., The Carboniferous floating forest—an extinct pre-Flood ecosystem, *J. Creation* **10** (1):70–91, 1996; creation.com/floating-forest.

The height of genome-wide association studies and what they tell us

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Recently, a news release was carried by several science media outlets regarding a large study that was a 'giant' step forward in explaining the genetics behind differences in height in humans.[1] This highlighted the findings of the GIANT (Genetic Investigation of ANthropometric Traits) Consortium which were published in *Nature*.[2] Based on genome-wide association (GWA) studies, they reported that adult height in humans is influenced by hundreds of genetic variants found in at least 180 different spots in the genome (loci).

Height in humans is highly heritable, but is also considered a classic example of a polygenic trait, meaning it is influenced by many genes. In the end, this study was able to explain about 10% of the variation in human height, though estimates suggest that genetics should account for closer to 80% of the variation. GWA studies provide valuable information for future research, as well as important reminders about the complexity of the genome.

Recent rise in GWA studies

In GWA studies, genetic markers are rapidly scanned across the genomes of many individuals to see which areas of the genome vary in association with a particular trait or disease. These studies have increased dramatically in the past five years with the increased use of high-throughput genotyping technologies. Many loci have been identified which are associated with particular diseases or traits. This methodology should continue to play a valuable role in genetic research. As with any statistically based study, there are important assumptions, advantages, and disadvantages associated with GWA studies.[3]

It is important to recognize that an association of one particular genetic marker, usually a single nucleotide polymorphism (SNP), with a particular trait does not necessarily mean it is the cause of that trait. However, the SNP is often near or within genes that play a role in determining a trait or are a risk factor for a particular disease. GWA studies are susceptible to false positives, so it is used as a screening tool. Once loci are identified, further research is done to determine what role, if any, particular genes have in producing a trait or disease.

One gene with a large effect

When Gregor Mendel studied peas, he chose obvious traits, like color, that varied discretely. These studies formed the basis of what is called Mendelian genetics. Essentially, one gene has two or more alleles, each producing a different form of the trait (e.g. yellow or green colored peas). One allele may be dominant over another, but the appearance of the trait is easily explained by understanding basic laws about inheritance. This would be an example where one gene has a large or very noticeable effect on a particular trait.

GWA studies occasionally identify these types of genes. For example, a GWA study on dogs, followed by further investigation identified a dominant mutation in one gene (RSPO2) responsible for furnishings (mustache and eyebrows) in wire-haired dogs; a recessive mutation in another gene (FGF5) responsible for long hair in the majority of dogs carrying that trait; and a mutation in a third gene (KRT71) responsible for curly hair.[4]

These types of examples are helpful in understanding some of the basics about genetics. It is interesting to note that a very small change in a gene will sometimes make a very big difference in the animal or person. Mendelian genetics is relatively simple and has proved useful. Despite the importance of these concepts, they are a drop in