Engenetics
The science of species

The three constraints or the three principles

> The elephant is reckoned the slowest breeder of all known animals, and I have taken some pains to estimate its probable minimum rate of natural increase; it will be safest to assume that it begins breeding when 30 years old and goes on breeding until 90 years old; if this be so, after a period from 740 to 750 years there would be nearly 19 million elephants descended from this first pair. Charles Darwin, *On the Origin of Species*, Chapter 3.

Charles Darwin, 1809–1882, wondered what could prevent this overrun of elephants … and eventually produced the theory that changed the face of human speculation, and made his name a household word. Darwin's original elephant (we here in fact consider an original elephant-pair) can be thought of as an initially small population that increases steadily to become a large one. Engenetics' exact method for measuring the scale of this increase is explained in the experiment with *Brassica rapa*, or field mustard (sometimes also called 'fast plant'), that is described on the engenetics web site [http://www.engenetics.net]. Granted Darwin's observation that the elephant population has the potential for a dramatic increase unless it is somehow curtailed, his musings on this matter can be rephrased as follows: what force, or forces, can prevent a given population from accelerating indefinitely, with possibly only infinity acting as a limit? This rephrasing allows the issues to be approached from the perspective of force and mass, inertia and acceleration, and the like. These are amongst the most precise and well-defined concepts of science. They enable the issues Darwin raises to be freshly approached, and with much greater rigour. Recast in this way, they are more explicitly addressed in the experiment with *B. rapa*, described on the engenetics web site [http://www.engenetics.net].

In the late 1940s and early 1950s, the British field researchers O.W. Richards and N. Waloff reported on a 5-year study they had conducted on the population dynamics of *Chorthippus brunneus*, a species of grasshopper, in the fields around Ascot, Berkshire, United Kingdom. *Studies on the biology and population dynamics of British grasshoppers*, 1954, Anti-Locust Bulletin, 17, pp 1-182. *C. brunneus* has a one-year cycle. In summer, the reproducing adults lay their eggs and then die. Although many eggs are lost, some do survive the winter. In spring, the surviving eggs produce a series of instar nymphs, ultimately resulting in a succeeding population of reproducing adults, which complete the cycle by laying their eggs, and then dying.

In their study, Richards and Waloff saw the *C. brunneus* population increase; collapse under environmental stresses; and then increase back again to its previous levels. As was also the case with the population of *Brassica rapa* that formed the subject of the experiment described on the engenetics web site [http://www.engenetics.net], the population of crickets was oscillating around the mean level required to establish its stable age equilibrium distribution, such that its intrinsic rate of increase is zero, within its environment.

Darwin's musings and these observations of population dynamics, which have been repeated and reported numberless times in the relevant literature, allow the description and logical derivation of the **three constraints** to which all biological populations are subject.

The first principle or constraint is the **constraint of constant propagation**. No species that wishes to survive can permit its numbers to fall to zero. Therefore, and as per **Law 1 of biology** and **Maxim 1 of ecology**, every species must endeavour to ensure that it remains viable and can continue. This is the constraint of constant propagation—and it can always be given a value.

The second principle or constraint is the **constraint of constant size**. This constraint suggests that, as with both *Chorthippus brunneus*, and *Brassica rapa* documented above, every species has a point of equilibrium size and equilibrium age distribution, and around which it tends to oscillate. At that equilibrium size, there is a one-to-one matching between each entity existing at any given point in a given generation cycle, and an entity of equivalent age existing at that self-same point in both a previous and a succeeding cycle. The equilibrium age distribution population figures for *B. rapa* can be found on the engenetics web site [http://www.engenetics.net]. But turning our attention to *C. brunneus* as a convenient reference example, then if the population numbers are expressed such that the average over the cycle is 1000, then the equilibrium age distribution population figures for *C. brunneus*, over its cycle of the generations, and such that its intrinsic rate of increase is zero, are:

493 first instar nymphs in the spring; declining to

157 fourth instar nymphs in early summer; declining to

88 adults in late summer; and then increasing via reproduction to

1,881 fertilized eggs in the autumn.

By oscillating in this way around a standard value of 1,000, *C. brunneus* is able to maintain itself as a viable species. (Note that the cycle through these values that the crickets undertake, also enables them to satisfy the first constraint above of constant propagation).

Biological entities must also satisfy a third and last principle or **constraint of constant equivalence**. (But see also **Law 2 of biology**). Let us consider one adult breeding example of the above cricket, *Chorthippus brunneus*. By the principles of constant propagation and constant size, it is now this cricket's "responsibility" to make sure that it satisfies the engenetic burden of fertility imposed upon it by leaving behind it (approximately) 22 fertilized eggs. Every such egg is then a probable successful path through the system … and such that it becomes the following year's successful, breeding adult, in turn leaving behind it c. 22 eggs. This fact in mind, let us now randomly select one of those 22 eggs and observe it to see if it is "the one" that makes it through. But for safety's sake …instead of discarding the other 21, we put them safely in an imaginary holding tank where they have everything they need to survive. We hold them in reserve just in case things don't work out with the one we have randomly selected.

And in fact … the chances that our randomly selected egg is indeed "the one" that is going to make it all the way through to adulthood and successful egg production are not good. The failure rate at this stage is just over 95%. Since each *Chorthippus brunneus* adult participates in the production of 22 eggs, the probability is quite high—disturbingly close to unity—that the egg we have randomly selected is going to come to some fateful and untimely end. But should it indeed come to an untimely end, we can simply replace it with another *C. brunneus* entity, also randomly selected from our holding tank. By the constraint of constant equivalence—the third constraint and force that makes a given species inherently biological—the entity we pick up from the holding tank, as a substitute, is in every way equivalent to the one that has been lost. It has the same mass and the same chemical and energetic signatures as the entity lost. The probability that this one will "make it" is now a little higher; but it is still more likely than not that it will also be lost. The failure rate is still over 90%, but the odds have changed a little more in our favour. If we can keep on substituting entities from our holding tank to replace any that are lost, then we can ultimately complete the cycle for the odds steadily improve. Thus all the entities left behind by a given generation of adults are in this way equivalent. And for as long as they are equivalent both to each other and to the adults who reproduced them, then for so long is the probability assured that the population or species can remain viable.

And these three principles or constraints of constant propagation, constant size, and constant equivalence join with the **four laws of biology** and the **four maxims of ecology** to allow rigorous conclusions to be drawn about the nature and behaviour of biological entities. They also and in every way support and endorse, all pertinent conclusions drawn by those sciences.

We can also notice that by using the principles of constant propagation, constant size, and constant equivalence, we can soon construct an entirely logical argument to show that although a species free from Darwinian evolution is theoretically possible, neither *Chorthippus brunneus* nor *Brassica rapa* is in fact such a species. In the case of *B. rapa* the precise values that refute any contention that it has been intelligently designed can be—and are—clearly stated on the engenetics web site [http://www.engenetics.net]. A similar value is in principle determinable for *C. brunneus* from a similar and suitably designed experiment. But even though the data available from the Richards & Waloff study cited above does not allow a precise figure to be calculated, it can nevertheless be definitively asserted, from the data that is provided, that *C. brunneus* is fully subject to the vagaries of the environment and thus to Darwinian evolution.

Furthermore—and again as demonstrated on the engenetics web site [http://www.engenetics.net] and as validated in the above experiment with *Brassica rapa*—all biological populations can be understood in three different ways:

1. As particles. By the principle of constant propagation, and through the work of Werner Heisenberg, biological populations can be understood as particles.

Viewed as particles, biological populations are subject to, and exhibit, the well-known properties of acceleration, inertia and the like characteristic of all dynamical objects. Specified values for these properites as exhibited by *B. rapa* are derived in the stated experiment; and they are provided in the data made available on the engenetics web site [http://www.engenetics.net].

2. As waves.By the principle of constant size, and through the work of Christiaan Huygens, Daniel Bernoulli, Niels Bohr and Erwin Schrodinger, biological populations can also be understood as waves.

Viewed as waves, biological populations go through repeating cycles of behaviour over time, while simultaneously oscillating around a mean value or axis. As exhibited in the experimental setup with *Brassica rapa*, and as validated on the engenetics web site [http://www.engenetics.net], **<u>all biological populations can be uniquely specified by three given properties</u>** analogous to the wavelength, frequency, amplitude and so forth of waves. This also allows for an entirely logical and orderly classificatory system of, and for, all biological species. That system is entirely consonant with, and indeed helps explain, the process of Darwinian evolution. And regarding the Linnaean system of classifaction, the method demonstrated on the engenetics web site [http://www.engenetics.net] entirely removes all arbitrariness from any attempt to classify species, for it is squarely based on the simple, unarguable, and easily measurable properties necessarily possessed by all populations … and as exhibited in the three given constraints, along with the given cyclical-generational properties.

3. As thermodynamic systems. And finally, by the principle of constant equivalence, and through the work of Sadi Carnot, James Joule, James Maxwell, Ludwig Boltzmann, Albert Einstein and Josiah Gibbs, biological populations can be understood as thermodynamic systems.

> Viewed as thermodynamic systems, biological populations possess properties that are mathematically equivalent to the entropy, enthalpy, pressure, temperature, internal energy and so forth possessed by, and required for, all thermodynamic systems. The experiment with *Brassica rapa*—along with the data and the analysis provided on the engenetics web site [http://www.engenetics.net]—unequivocally and explicitly demonstrate the existence and the magnitudes of these specified properties … and it unambiguously derives and states their precise values.

When these three principles or constraints are combined with the **four laws of biology**, and the **four maxims of ecology**, they complete the set of irreducible axioms that establish—and bring a necessary rigour to—the biological sciences, and as is discussed and demonstrated on the engenetics web site [http://www.engenetics.net]. They in particular help to demonstrate the impossibility, even in abstract form, of those theories proposed to explain biological entities but that are centred on the premise of the everlasting and unchanging fixity of species The argument explicating this is available on the engenetics web site [http://www.engenetics.net].

© yefrewenchi, May 2010