Rivista di Biologia - Biology Forum 82 (2), 1989, 209-216

On the beauty of sex and the truth of mathematics

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ABSTRACT : Sex is a kind of language, spoken across a species, where genetic experiences from one reproductive line can be transferred to another one. A step forward can actually be imagined if we think of a 'value' being attached to the mating partner. The criteria must then operate at a quite abstract and general level the aesthetic *one. After all, basic rules may be of general applicability: aesthetics and physics are much the same thing.*

Naive questions often call for sophisticated answers. Why flowers are considered beautiful always puzzled me. With the 'why' I intend the philosophical *quia*, the deep cause or connection, not the *propter hoc*, i.e., the actual contrivances thorugh which that beauty is expressed.
Flowers are, in fact, vexillar structures designed to capture the attention of pollinating insects. As is true for many other things in the biological realm, they select for their efficiency, in a closed loop with insect choices. Every mutation that fails the efficiency test will not survive — it will fade out. During million years of probing, every possible configuration has presumably been tested, so finally the flower we admire today can be considered a kind of ectoplasm, a transcodification, of the physics, physiology, neurology, and *value system* of the insect. Why this value system should be the same for insects and for human beings — objects so far apart biologically — is obviously a most intriguing mystery.
Because flowers are so vastly different, as are the insects serving them, the unifying concept must be quite abstract, somewhat like the value system mentioned above, with physics and chemistry sitting somewhere behind the concept. The question can them be reformulated : why does a subset of my value system coincide with that of pollinating insects? Because my appreciation of flowers is intuitive and emotional, the coincidence must lie in the area of aesthetics. This lead to my first suspicion of philosophical importance — that aesthetics must be somehow 'objective', perhaps not like physics and chemistry, but still somehow real and measurable with tools yet to be devised.

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This question of objectivity kept me pondering for years, because it implies, like any other biological function (take, for example, the sense of smell), a process of mutation and selection in view of a final objective, that of survival, if we want to draw the outer wrap. The problem was, in essence, to identify the level and context in which this objective aesthetics actually operate. Heuristically, they should be a selective filter in information flow, and their generality suggests that they operate at a deep level. But where ?

Some years ago I was studying the question of the advantages for a species in having sex. What the advantages are is still debated (*clads* vs. *clones*), but advantages there must be if sex is so solidly entrenched in most of the biological realm to the point that even monocellular organisms have developed tricks to transfer DNA from one to another.

Right or not, my idea was that sex is a kind of language, spoken across a species, where genetic experiences from one reproductive line can be transferred to another one. Consequently, information gathering about favorable mutations becomes a species affair, and that increases enormously the rate at which a sexed species can evolve, by contrast to one where information can be transferred only vertically, from father to son, so to speak. Furthermore, bits and pieces of this information can be scattered around within the species, creating a genetic pool, where it is kept fluid for recombination. This keeps the species flexible and resilient within relatively short time constants, even when generation times are many orders of magnitude longer than in monocellular organisms.

As this information swapping technique becomes more and more sophisticated along evolutionary lines, I asked myself if the process of stochastic recombination cannot itself be improved. We observe that animals, from deer to fruit flies, seem to go through elaborate rituals just to avoid this stochasticity, presumably for good reasons. To take a precise example, the male fruit fly starts courting the female by standing eye to eye in front of it. The female then swings right and left, swiftly and aperiodically, and the male tries to follow. Only if he is able to follow her dance precisely the male is accepted as a mate. Obviously, the female checks the neuromuscular fitness of the partner as a criterion of choice — perhaps only one of many fitness tests.

A step forward can actually be imagined if we think of a 'value' being attached to the mating partner, connected with the probability of success of the future offspring in the struggle for life. The process is made abstruse by the fact that the message has to be extracted by the observation of the partner, with no direct connection to the offspring still to come, and only a partial one to the environment into which it will move.

The criteria must then operate at a quite abstract and general level. Let me call it the *ethical* level, using an anthropomorphic concept or, by analogy with the human choice of partners in humans, the *aesthetic* level.

If a certain mechanism of choice, even simpl eand crude, gives a selective advantage, however small, then it will become fixed. It will progressively expand and improve, as will any other positive character. The choice is made at the brain level, and can be considered 'instinctive' information processing.

The instinctive program has to be very subtle, intrinsically, because it has to match somehow the great complexity of the external world, and also be very *true*. The way this is insured is very simple. Signals are sent out and come back, filtered by offspring selection, insuring a progressive tuning between the signal generator and the filter. But the filter is the external world and so the generator progressively acquires a 'knowledge' of universals, actualized in form of (instinctive) criteria of choice, i.e., of *value tags*.

The process is akin to the well-known children's game, 'Battleship', in which each of two players draws a war fleet on a grid of squares and 'shoots' at the opponent's fleet by naming coordinates. If a ship is hit, the feedback message is 'hit'. This yes or no, success or failure string of information permits the reconstruction of the enemy fleet's location and distribution.

Tools tend to expand their niche. The tooth so useful in crunching roots can occasionally crunch an enemy leg, or the hand so swift in grabbing branches can grab a screwdriver to fix a watch. The natural way to expand here is to apply value tags to objects other than potential mates. After all, we all float in the same physical world, and basic rules may be of general applicability. My outstretched statement here is that aesthetics and physics are much the same thing.

To give some support to this naughty statement, I will take a couple of examples from our daily life. Mathematics is formally a logical game, where possible interactions between certain statements, the axioms, are constructed using certain rules and called theorems. The process is relatively simple and can be computerized. However, when the theorems so generated are presented to a mathematician, his reaction will be one of boredom. The theorems are correct, he will say, *but they are trivial.* Because they are correct, they are mathematically unimpeachable ; but when he calls them trivial, he implies a value system external to the

mathematical one. In other words, mathematics provides a large grid of neutral statements, actually tautologies, to which the mathematician, for his own reasons, applies value tags. If one listens to creative mathematicians talking, it is clear that the tagging machine is aesthetics.

If this point of view is accepted, a certain number of things start acquiring significance or finding an explanation. A mathematical statement is a tautology, and this occasionally bothers purists. But its value comes from the fact that it has been *selected* out of a sea of equivalent tautologies, and brought to life by implicitly stating that it belongs to the *physical* world. This is why, the mystery unveiled, mathematics is so efficient in describing the external world. It comes from there, and its fitness has been painfully checked and rechecked for eons.

If one trembles at such complexity reduced to a trivial game such as 'Battleships', parallel examples abound. Our body chemistry and, by the way, that of a minute bacterium are orders of magnitude more complex and subtle than anything man has been able to conceive, much less produce. And these chemistries operate with magical smoothness and perfection.

At this point we can go back to square one and observe that the chemistry of the insect intersects amply with ours, especially in terms of basic building blocks. DNA is there, as is ATP and many other constituents. So an intersection in our value systems should not be so disturbing. We and the insects live in the same physical world. A curious and perhaps important observation is that when certain dull flowers are photographed in the spectral sensitivity region of their pollinators, they display beautiful and stimulating patterns — a kind of negative check of my hypothesis. Every tool, as I said, tries to expand its niche. Nimble hands only rarely hold branches nowadays. A value system can be precious outside the original area of mate selection to assess right and wrong. It is curious that children and primitive languages often confuse the words for 'beautiful' and 'good'.

Note, too, that an aesthetically pleasing environment releases stresses d anxiety. When people in the Middle Ages, for social and political reasons, had to live in walled cities, they poured beauty into them, to make them holy, *natural*, and reassuring. With these consoling notes, I close my little exercise.

Laxenburg, February 1988

● The Italian text, to be found in the Bilingual Edition, was omitted. The page numeration is the same as in the Bilingual Edition.