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## AP Content :: Sensible Science

### Bombardier Beetles and Airplane Engines

by Brad Harrub, Ph.D. and Bert Thompson, Ph.D.

Imagine sitting on an airplane and hearing the following chilling words: “Ladies and gentleman, this is your captain speaking. We have lost one of our engines, and are having trouble re-igniting it.” Not exactly what you want to hear as you look out the little oval window at the ground 30,000 feet below. Thanks to a half-inch-long bug, passengers may never have to worry about hearing such an announcement. Scientists at the University of Leeds in Great Britain have been granted research funds to study the jet-based defense mechanism of a tiny creature known as the bombardier beetle, in the hope that it will help them learn how to re-ignite a gas-turbine aircraft engine in mid-flight. Jane Reck observed:

The bombardier beetle defends itself by squirting predators (ants, frogs, spiders) with a high-pressure jet of boiling liquid in a rapid-fire action called pulse combustion. Building on work by Professor Tom Eisner at Cornell University, the new project will set out to improve understanding of the beetle’s unique pulse combustion and nozzle ejection mechanism. It also aims to identify how combustion engineers could exploit this understanding to practical effect. For example, knowledge gained could aid the development of a device that helps relight aircraft engines at high altitude by squirting plasma into the engine’s combustion chamber more accurately (2003, parenthetical item in orig.).



Image courtesy of Thomas Eisner.

What is it about this tiny animal that has the aircraft industry sitting up and taking notice? The bombardier beetle has a pulse defense mechanism that works in the following manner. Two chemicals, hydroquinones and hydrogen peroxide, are produced in glands, and then stored in a large reservoir housed within the beetle’s abdomen. When the animal feels threatened, muscles surrounding the reservoir contract, pushing the chemicals through a muscle-controlled valve into a heart-shaped reaction chamber lined with cells that secrete peroxidases and catalases—oxidative enzymes. The enzymes quickly break down the hydrogen peroxide, and catalyze the oxidation of the hydroquinones into p-benzoquinones—compounds that are well known for their irritant properties. This chemical

reaction results in a release of free oxygen, and causes a substantial liberation of heat. The beetle then is able to eject this spray out a revolvable turret—at **100° C!**—in a pulse-like fashion at a rate of 500 pulses per second (see Aneshansley and Eisner, 1969; Dean, et al., 1990; Eisner, et al., 2000).

Can you imagine trying to explain all of this intricate design by “chance evolutionary processes” occurring over millions of years in nature? And yet, evolutionists maintain that there are logical step-by-step explanations for this unique bug’s ability to have a chemical reaction chamber inside its abdomen. The truth is, however, that only intelligent design can explain how the beetle is able to produce the proper chemicals, keep them separate until they are needed, manufacture the right enzymes, and propel the hot mixture into the face of its enemy.

In describing the defensive spray of the bombardier beetle, Jeffrey Dean and his colleagues noted:

The defense spray of the bombardier beetle *Stenaptinus insignis* is ejected in quick pulses (at about 500 pulses per second) rather than a continuous stream.... The ejection system of the beetle shows basic similarity to the pulse jet propulsion mechanism of the German V-1 “buzz” bomb of World War II.... The abdominal tip acts as a revolvable turret that enables the beetles to aim the spray in all directions.... We report here that the bombardier beetle spray is emitted not as a continuous stream but as a pulsed jet, **in analogy with fluid delivery systems known from technology but not from animal glands** (1990, 248:1219, parenthetical item in orig., emp. added).

In the conclusion of that study, the authors went on to observe: “A striking technological analogy of the bombardier beetle is provided by the notorious V-1 ‘buzz’ bomb of World War II. Both the beetle and the V-1 engender a pulsed jet through an intermittent chemical reaction, and both have passively oscillating valves controlling access to their reaction chambers” (248:1221). Years earlier, a *Time* magazine article featured these amazing creatures, and noted:

Its defense system is extraordinarily intricate, a cross between tear gas and a tommy gun. When the beetle senses danger, it internally mixes enzymes contained in one body chamber with concentrated solutions of some rather harmless compounds, hydrogen peroxide and hydroquinones, confined to a second chamber. This generates a noxious spray of caustic benzoquinones, which explode from its body at a boiling 212°F. What is more, the fluid is pumped through twin rear nozzles, which can be rotated like a B-17’s gun turret, to hit a hungry ant or frog with bull’s-eye accuracy (see “Drafting...,” 1985, p. 70).

In a similar study investigating the defense mechanism of the bombardier beetle, Thomas Eisner and Daniel Aneshansley commented on the beetle’s exceptional ability to aim the hot mixture as it is sprayed from its body. They noted: “...many carabids [ground beetles—BH/BT] have the capacity to aim their spray in different directions. None are perhaps better marksmen than the so-called bombardier beetle.... Although it was known that the bombardier beetles can aim their spray revolving the abdominal tip, the degree of precision with which they target their ejections had escaped notice” (1999, 96:9705).

Jane Reck noted that the new research project—hoping to capitalize on many of the designs found within the bombardier beetle—would involve computer-based numerical and mathematical modeling. She commented: “Initially it will focus on understanding the beetle’s heart-shaped miniature combustion chamber.” Andy McIntosh, team leader for the project went on to observe:

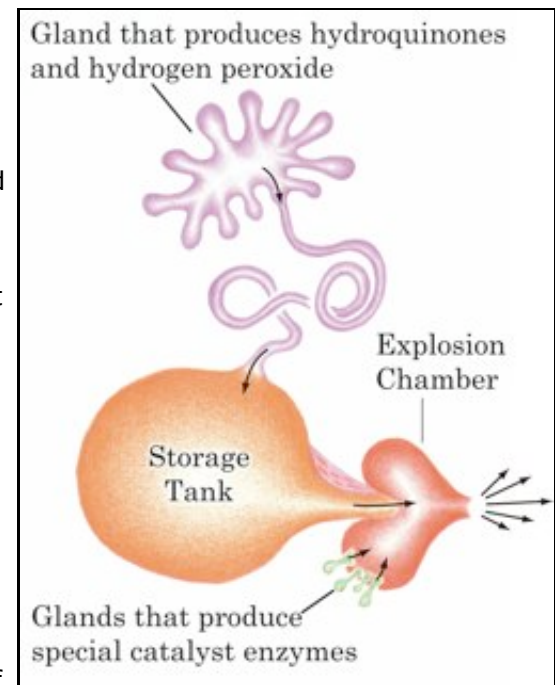
The bombardier beetle’s defense mechanism represents a very effective natural form of combustion. Copying such natural mechanisms is a part of the growing field of biomimetics where scientists learn much from intricate design features already in nature. Understanding this beetle better could lead to significant advances in combustion research (as quoted in Reck, 2003).

So, we find ourselves trying to model technology after these amazing creatures, and yet evolutionists still scream there is no intelligent design and that, in fact, those special chambers and the ability to produce such chemicals are simply cosmological accidents. The TalkOrigins.org Web site (a staunch defender of evolution), for example, posted an article on bombardier beetles written by Mark Isaak. In the article, Isaak asked:

Do bombardier beetles look designed? Yes; they look like they were designed by evolution. Their features, behaviors, and distribution nicely fit the kinds of patterns that evolution creates. Nobody has yet found anything about any bombardier beetle which is incompatible with evolution. This does not mean, of course, that we know everything about the evolution of bombardier beetles; far from it. But the gaps in our knowledge should not be interpreted as meaningful in themselves (1997).

He then went on to list a step-by-step process in which he gave a hypothetical explanation of how this complex design could have arrived via chance processes. **Fifteen steps later**, he felt as though he had accomplished his task. And yet, many of his steps are flimsy at best.

Consider just two examples. Step 9 noted: "Muscles adapt which close off the reservoir, thus preventing the chemicals from leaking out when they're not needed." Prior to this step, the only mention of muscles is step 4, where Isaak observed: "Muscles are moved around slightly, allowing them to help expel the quinines from some of them." Where did these muscles originate? Evolution should be able to explain the appearance of these unique muscles. Surely Mr. Isaak understands that muscles are living cells that contract when stimulated by nerves; thus, it hardly is plausible to suggest that muscles simply "moved around slightly." Did the nerves and blood vessels supplying the muscles "move around slightly," too? And what, pray tell, would prevent the muscles from "moving back"? Also, how did the muscular tissue "know" just how tightly it needed to contract to "prevent the chemicals from leaking out when they're not needed"? And, there is a problem of an even greater magnitude. As Eisner and Aneshansley lamented: "Although we know that the males of this species also aim their discharges, they appear to do so with an apparatus that differs somewhat from that of the female. Thus, for instance, for ejecting forward over the back males make use of a single broad reflective shield, instead of the pair of devices used by the female" (1999, 96:9707). Mr. Isaak, therefore, also must explain how the two genders evolved different muscles and mechanisms. **It is not enough for evolutionists simply to suggest that the muscles "moved around" and then "adapted."** Such a "just-so" story is exactly that—a "just-so" story.



Additionally, step 13 in Mr. Isaak's list noted that "the walls of that part of the output passage become firmer, allowing them to better withstand the heat and pressure generated by the reaction." The evolutionist's answer is that we simply can "firm up the walls," and everything will be fine. But **how** did those walls become firmer? Whence came that "firmer" material? Also, how did all the constituents (i.e., nerves, blood vessels, etc.) that are necessary for the construction and success of this reaction chamber evolve the ability to withstand added pressure and heat? Isaak did not bother to explain how bombardier beetles are able to repeatedly produce boiling liquids within their bodies without injuring themselves. How many other animals exist that are able to house liquids that reach 100° C (212° F)? Also, how is this creature able to spray this irritating liquid at attackers, even though it often sprays itself in the process—yet without any damage to its own body? Eisner and Aneshansley recognized this conundrum when they wrote: "And of course, there is the vexing problem of how the beetle, which inevitably

drenches itself when discharging, withstands the heat and irritancy of its own spray" (1999, 96:9708). And we won't even inquire as to how this amazing animal was able to generate the precise amounts of each chemical and enzyme needed to perform this chemical reaction.

Evolutionists may declare that they see no design to the bombardier beetle, and may go to great lengths to sketch out a hypothetical step-by-step method in which they believe the creature's development could have occurred. But the evidence points to an intelligent Designer.

Is it just us, or does anyone else find it ironic that evolutionists continue to deny that any design is evident in the bombardier beetle, yet scientists have been awarded huge government grants to study that design? One does not get a poem without a poet, a law without a lawgiver, or a painting without a painter. And one does not get design without a—Designer!

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