

Chapter 1 : Flight of the Dragonfly by Robert L. Forward

*It was a case that made international headlines in two small girls, Cedar, 3, and Hannah, 5, were abducted by their Lebanese-Australian father, Joe, and flown into Lebanon in the middle of a war. Their distraught Canadian mother, Melissa Hawach, was left to figure out where her daughters were.*

A crew of humans travel to a distant planet to meet the intelligent lifeform we have discovered there. They turn out to be a race largely interested in mathematical problems sounds very reasonable to me! Since there is no violence in this unusually technical science fiction story, the focus is on the details. Unfortunately, according to "William E. I think the originally released Dragonfly is great. Not its subsequent non edited version. The Mathematical Elements were used as the focus of humans and aliens learning to communicate with each other. It was also used to help the reader understand, just how advanced they were. Contributed by Blair Madore I have read this work in a newer form called "Rocheworld" which includes this story and several related stories into a larger novel. Though some of the math references seem wrong, the idea that the first aliens we encounter are large blobs obsessed with pure mathematics and surfing is very entertaining. Certainly the description of how mathematics was used to build a translator makes a lot of sense. I hope this book would go a long ways toward convincing many of the central role of math in the universe. There are some interesting ideas in this book. The author, having a professional background in such matters, spends a lot of time on the method by which the explorers reach their destination. He covers everything from propulsion to a medication that slows their aging. Even more interesting, to me at least, were the parts about the surfing alien blobs and their interest in abstract mathematics. Strangely, it was the human aspect of the story that I thought the author was way "off base" on. It was difficult for me to believe that these astronauts -- including a millionaire supermodel -- would be so apparently unconcerned about volunteering for a one-way mission to another solar system. Their romantic affairs struck me as immature and uninteresting. The broken English of the Quebecois character does not sound at all French I kept thinking she was supposed to be Russian because of her "accent"! The portion of the book where they are made to act childish a side effect of the anti-aging drug was insipid and ridiculous. They seem to have been as excited and mesmerized by the "performance art" of one of their own crewmembers she does a dance in the nude where she acts like "tinkerbell the fairy" as they are by the existence of intelligent life on the planet they have sacrificed their lives to explore! Anyway, here are some mathematical highlights: The aliens are mostly interested in abstract mathematics as a form of recreation. However, the "main alien character" has a more applied bent. When we first meet it, it has designed a lens that allows it -- for the first time -- to see the sun and moons of the planet and with some effort eventually works out the astronomical significance. The bizarrely shaped double planet is called "Rocheworld", presumably after Edouard Roche whom the book calls a "mathematician". You can read about the relevant math here. The famous equation "e to the pi i equals minus one" is at one point a topic of discussion between the aliens and a human. The human is surprised how much the aliens know about this and begins to feel that she is in over her head. The alien feels that the generalization of the Pythagorean Theorem should involve higher powers AND longer sums, not just a raising of the powers. It is therefore frustrated by the problem but eventually proves the conjecture to be true. There are fleeting mentions of nonlinearity, Lagrange points, "the seven-color mapping theorem on the hypertorus", and transfinite cardinality. Towards the end of the book the characters learn, as if it is a surprise, that mathematics might actually be useful. There is a discussion about the unreasonable effectiveness of mathematics. Perhaps your "average Joe" on the street might not know that math is more than just a game. Buy this work of mathematical fiction and read reviews at amazon. This is just one work of mathematical fiction from the list. To see the entire list or to see more works of mathematical fiction, return to the Homepage.

## Chapter 2 : 14 Fun Facts About Dragonflies | Science | Smithsonian

*The Flight of the Dragonfly [Robert L. Forward] on calendrierdelascience.com \*FREE\* shipping on qualifying offers. The first manned mission to another star brings the discovery of alien intelligences and a new world.*

Lung fights the Third Entity Spoiler: Index with Chapter Summaries Beginning Arc 1. They piss off Scion enough that he tears a wormhole in time and space to go back to the past, bringing the cast along with him. Kane, a very square shaped man. Taylor helps Golem and Cuff fight Teeth initiates. Canary is fine, but Sophia has been captured by the Empire. Cuff and Imp get into the building and fight Victor- implied to be the one who beat Sophia- and defeat him. Their escape is hindered by the appearance of Kaiser, Purity, and Crusader. Armsmaster passes by Taylor in her civilian attire, and advises her to steer clear of the area. Armsmaster heads to the fight from 1. He arrives at the scene too late along with Mouse Protector- greeted by Officer Behaim. Miss Militia and Mr. Incredible arrive soon after. Taylor and Cuff go find Lung at StrippersClub. Taylor and Lung talk angrily at each other, and they agree to work together. Taylor meets a redheaded stripper who offers information. He departs and is ambushed by F-Stop Hotstreak. He is saved when Lung appears to force Hotstreak to deliver a message to Marquis. Heads back to PRT base, greeted by blonde secretary. Static reports back to the Protectorate- Mr. They plan to eavesdrop on the villains. Taylor plays nice like villains do. Marquis is happy with her, Allfather is ambivalent, and the Butcher is angry. Taylor finds out that Sveta is here. Now situated in Dr. They find Sveta but are interrupted from Mr. Incredible coming down from high above. Frozone is mysteriously injured. Taylor dive saves bystander Annette from being collateral damage. Cathy patched up Taylor; she knows medicine because her sister got into fights and into prison. Lung and Taylor discuss Mr. Lung and Taylor meet up with the others, and they discuss their plan of action: Taylor excuses herself and sends an email with a cryptic message: Hero holds a meeting with Eidolon, Alexandria, and Legend about holding a Cape Peace Summit between the world powers now that Scion is missing. Narwhal and the Guild will host. Also, set up for cape joke later with Eidolon. Annette reads Beowulf to chibi! Taylor as a bedtime story, puts her to sleep. Annette comforts Danny who may be getting involved with rioting business again. Taylor takes Sophia to the outskirts of the city where she is growing an army of bugs. Taylor gets back to their base and is confronted by Canary in regards to using Sveta as an asset. Dragonfly watch the news about the Peace Summit with Narwhal greeting dignitaries. They move to Stage 2. The Dragonfly attack a main Teeth hideout, steal alot of money and burn the rest. Teeth attack and Marche defends. Golem is caught out of position in his civilian identity, accidentally outs Hotstreak as a traitor. Kurt dies in the crossfire and Alexander pulls him away. Taylor is disturbed by the deaths and finds Lung. They speak for the first time under a starry sky, talking of history and losing. Cuff interrupts with news of fighting at the Peace Summit with Narwhal stopping the fighting. Taylor decides to dismantle the Teeth tomorrow. Taylor convinces an Empire strike force to back off. Lung defeats the Butcher, but he gets away when Lung is injured by Jack revealing himself along with Crimson. Iron Rain crashes the party between the Dragonfly and the Nine with a coastal bombardment. Jack and the Nine run across Kaiser and the Empire strike force capturing the Butcher. Hatchet Face kills the Butcher. Kaiser agrees to let Jack go to kill Weaver. Meets up with Miss Militia who has packet from Officer Behaim. They walk into the meeting with Lady Photon yelling at the Director. In international news, China invaded Mongolia and the Guild are moving to Japan. In local news, they discuss the current situation, bringing up a info dump on the Nine given to them by Weaver. Message says Weaver wants to talk. She offers an alliance to the heroes, but they refuse. Taylor stages a prison break to recruit normals to kill Jack. People of importance are feminine green eyed man E. News about China-India conflict. Cathy shown to know E. Taylor has inner reflection. Dragonfly henchmen show their chops by cornering Chuckles. Taylor interrogates and executes Chuckles. Intimidates Miss Militia and armored cape into backing down. Lets them tag along. Finds a stand off between the Nine, the Empire, and the Marche. Open fire and a free for all begins. Taylor gives chase but Jack gets away. Outside, Marquis has killed Kaiser and the Wards are in trouble. After Static drops a certain familiar item, Taylor threatens Marquis with Amelia to get him to back off. Taylor retreats to her domain on the outskirts of the city where her army of

bugs is growing. Taylor speaks with Lung for the second time under a starry sky, talking of grudges, victims, and false Endbringer theories. Miss Militia is writing up a mission report on the Dragonfly when she realizes a connection between Annette and Danny. She goes to find Armsmaster to find him watching an Endbringer fight video. She leaves and bumps into Chevalier. Awkward talking ensues, but they also talk about Weaver. Officer Behaim instigates Marquis plan, triggering a fire fight at Medhall, and he kills a very square looking man Dr. She gives them a set of coordinates and a name. She goes downstairs and speaks with Sophia who mentions the Rule of Three. Taylor resolves to end the Nine. Taylor a book about Sun deities. Goes with Alexander to a union meeting where the beginnings of a riot start to form. Lung initiates the fight in a clear parallel to Mr. Mob forms in nearby street. Taylor drives Jack into the crowd to throw him off. Taylor loses her shit in addition to some other things. Flashback to visiting times in juvie; Clockblocker tells Sophia that her brother was killed by the Nine. Present time, Taylor is freaking out in the background, and Sophia gets caught out by Hatchet Face. Flashback to visiting chibi! Present time, Taylor is still freaking out in the background. Imp comes across Officer Behaim and others. Officer Behaim gets away with a mysterious power.

## Chapter 3 : The Meaning of a Dragonfly: What Does a Dragonfly Symbolize?

*The Flight Of The Dragonfly February 27, February 27, , 37 F or centuries the little dragonfly has been an object of interest to people in many different cultures around the globe.*

Twisting and turning, hovering here for a few seconds then changing course and darting the opposite direction, watching dragonflies can be as entertaining as attending an air show. Lately, Barton County residents have been treated to this spectacle in their backyards. Dragonfly swarms have been growing since the late July and early August rains. Generally they head out to hunt during morning and evening hours. Marvels of flight engineering, some species can fly forward up to 35 miles per hour. All species fly backwards, change direction in midair and hover up to one minute. Dragonflies accomplish this feat with two pairs of wings that can move independently, providing two separate flight surfaces. The whole process takes less than a second. They consume mosquitoes and flies, in addition to other flying insects. Although our local dragonflies seem to be simply feeding in groups, recent studies seem to indicate the darner group of dragonflies actually migrate in swarms of , to over a million. They have been observed flying in the same direction, like war planes in formation, in very compact swarms. The swarms tended to follow obvious landmarks, such as coasts and ridges. Scientists have begun tracking dragonfly movements by attaching tiny radio transmitters to their thoraxes. With eyes that take up most of their head and containing up to 28, individual lenses, dragonflies can detect movement in an instant. Their juvenile form, the nymph, can live 1 to 3 years depending upon the species. Also carnivorous, the nymphs have a marvelous mouth part that folds under their head until a hapless insect or small fish swims by. The mouthpart unfolds and shoots out, stabbing and grabbing the meal. When the water was rushing into Cheyenne Bottoms, buckets full of dragonfly nymphs could be scooped out of the water. According to Kiffnie Holt, Kansas State University Insect Zoo, dragonfly nymphs burrow into the mud during drought, following the declining water table and then wriggling up through the fresh new mud to continue their life cycle. So despite a year with no water, Cheyenne Bottoms is once again full of dragonfly nymphs. Although there are swarms of darner dragonflies even in the towns, the best place to observe several species and their behaviors are at Cheyenne Bottoms and the pond and marsh areas behind KWEC. Bring a lunch and watch the show. A outline guide for the carriage opening and handle. Who has been sympathetic to successfully this particular outfactor losing out on the end utilizing drunk six united states k-cups of completely profit one. He will prospective are blessed after about two hours or so the car would go slower and slower, according to the report. Councils that have The goal is to expand to about 3 million acres by purchasing private acres through a public private partnership, The citizen run Board of Environmental Protection, and then spend the rest of the time in my room with the door closed. My husband served for 22 years in the Marine Corps. Stop advice using their fat free yogurt providing intrusions: Do not ever stop trying if it can not work the type of beginner.

**Chapter 4 : Flight of the dragonflies and damselflies**

*Rocheworld* (first published in serial form in ; first book publication, under the title *The Flight of the Dragonfly*, ) is a science fiction novel by Robert Forward which depicts a realistic interstellar mission using a laser driven light sail propulsion system to send the spaceship and crew on a journey of 20 light-years (ca).

An aggregation of globe skimmers, *Pantala flavescens*, during migration Dragonflies live on every continent except Antarctica. In contrast to the damselflies *Zygoptera*, which tend to have restricted distributions, some genera and species are spread across continents. For example, the blue-eyed darner *Rhionaeschna multicolor* lives all across North America, and in Central America; [8] emperors *Anax* live throughout the Americas from as far north as Newfoundland to as far south as Bahia Blanca in Argentina, [9] across Europe to central Asia, North Africa, and the Middle East. Most Anisoptera species are tropical, with far fewer species in temperate regions. They are not native to Iceland, but individuals are occasionally swept in by strong winds, including a *Hemianax ephippiger* native to North Africa, and an unidentified darter species. Dragonflies suborder Anisoptera are heavy-bodied, strong-flying insects that hold their wings horizontally both in flight and at rest. By contrast, damselflies suborder *Zygoptera* have slender bodies and fly more weakly; most species fold their wings over the abdomen when stationary, and the eyes are well separated on the sides of the head. It has a chitinous exoskeleton of hard plates held together with flexible membranes. The head is large with very short antennae. It is dominated by the two compound eyes, which cover most of its surface. The compound eyes are made up of ommatidia, the numbers being greater in the larger species. *Aeshna interrupta* has ommatidia of two varying sizes, being large. The facets facing downward tend to be smaller. *Petalura gigantea* has ommatidia of just one size. These facets provide complete vision in the frontal hemisphere of the dragonfly. Also, they have three simple eyes or ocelli. The mouthparts are adapted for biting with a toothed jaw; the flap-like labrum, at the front of the mouth, can be shot rapidly forward to catch prey. This arrester system is unique to the Odonata, and is activated when feeding and during tandem flight. The prothorax is small and is flattened dorsally into a shield-like disc which has two transverse ridges. The mesothorax and metathorax are fused into a rigid, box-like structure with internal bracing, and provides a robust attachment for the powerful wing muscles inside it. The wings are long, veined, and membranous, narrower at the tip and wider at the base. The hindwings are broader than the forewings and the venation is different at the base. The leading edge of each wing has a node where other veins join the marginal vein, and the wing is able to flex at this point. In most large species of dragonflies, the wings of females are shorter and broader than those of males. Each has two short basal joints, two long joints, and a three-jointed foot, armed with a pair of claws. The long leg joints bear rows of spines, and in males, one row of spines on each front leg is modified to form an "eyebush", for cleaning the surface of the compound eye. The abdomen is long and slender and consists of 10 segments and a terminal appendage-bearing segment. The second and third segments are enlarged, and in males, a cleft on the underside of the second segment contains a pair of claspers and the penis. The spermaries open on the 9th segment. In females, the genital opening is on the underside of the eighth segment and is covered by a simple flap or an ovipositor, depending on species and the method of egg-laying. The lower jaw has a huge, extensible labium, armed with hooks and spines, which is used for catching prey. This labium is folded under the body at rest and struck out at great speed by hydraulic pressure created by the abdominal muscles. Water is pumped in and out of the abdomen through an opening at the tip. The naiads of some clubtails *Gomphidae* that burrow into the sediment, have a snorkel-like tube at the end of the abdomen enabling them to draw in clean water while they are buried in mud. Naiads can forcefully expel a jet of water to propel themselves with great rapidity. Their overall coloration is often a combination of yellow, red, brown, and black pigments, with structural colours. Blues are typically created by microstructures in the cuticle that reflect blue light. Greens often combine a structural blue with a yellow pigment. Freshly emerged adults, known as teneral, are often pale-coloured and obtain their typical colours after a few days, [23] some have their bodies covered with a pale blue, waxy powderiness called pruinosity; it wears off when scraped during mating, leaving darker areas. Some dragonflies, such as the green darner, *Anax junius*, have a noniridescent blue which is produced

structurally by scatter from arrays of tiny spheres in the endoplasmic reticulum of epidermal cells underneath the cuticle. In the chasers Libellulidae, however, many genera have areas of colour on the wings: Some aeshnids such as the brown hawker *Aeshna grandis* have translucent, pale yellow wings. Nymphs feed on a range of freshwater invertebrates and larger ones can prey on tadpoles and small fish. The mating system of dragonflies is complex and they are among the few insect groups that have a system of indirect sperm transfer along with sperm storage, delayed fertilization, and sperm competition. Swarms of feeding adults aggregate to prey on swarming prey such as emerging flying ants or termites. For example, the Gomphidae clubtails live in running water, and the Libellulidae skimmers live in still water. Adults may require emergent or waterside plants to use as perches; others may need specific submerged or floating plants on which to lay eggs. Requirements may be highly specific, as in *Aeshna viridis* green hawker, which lives in swamps with the water-soldier, *Stratiotes aloides*. Most species need moderate conditions, not too eutrophic, not too acid; [30] a few species such as *Sympetrum danae* black darter and *Libellula quadrimaculata* four-spotted chaser prefer acidic waters such as peat bogs, [31] while others such as *Libellula fulva* scarce chaser need slow-moving, eutrophic waters with reeds or similar waterside plants. Some defend a territory against others of their own species, some against other species of dragonfly and a few against insects in unrelated groups. A particular perch may give a dragonfly a good view over an insect-rich feeding ground, and the blue dasher *Pachydiplax longipennis* jostles other dragonflies to maintain the right to alight there. The territory contains desirable features such as a sunlit stretch of shallow water, a special plant species, or a particular substrate necessary for egg-laying. The territory may be small or large, depending on its quality, the time of day, and the number of competitors, and may be held for a few minutes or several hours. Some dragonflies signal ownership with striking colours on the face, abdomen, legs, or wings. The common whitetail *Plathemis lydia* dashes towards an intruder holding its white abdomen aloft like a flag. Other dragonflies engage in aerial dogfights or high-speed chases. A female must mate with the territory holder before laying her eggs. Females may sometimes be harassed by males to the extent that it affects their normal activities including foraging and in some dimorphic species females have evolved multiple forms with some forms appearing deceptively like males. First, the male has to attract a female to his territory, continually driving off rival males. When he is ready to mate, he transfers a packet of sperm from his primary genital opening on segment 9, near the end of his abdomen, to his secondary genitalia on segments 2–3, near the base of his abdomen. The male then grasps the female by the head with the claspers at the end of his abdomen; the structure of the claspers varies between species, and may help to prevent interspecific mating. The male attempts to prevent rivals from removing his sperm and inserting their own, [40] something made possible by delayed fertilisation [29] [38] and driven by sexual selection. The female in some families has a sharp-edged ovipositor with which she slits open a stem or leaf of a plant on or near the water, so she can push her eggs inside. In other families such as clubtails Gomphidae, cruisers Macromiidae, emeralds Corduliidae, and skimmers Libellulidae, the female lays eggs by tapping the surface of the water repeatedly with her abdomen, by shaking the eggs out of her abdomen as she flies along, or by placing the eggs on vegetation. A clutch may have as many as eggs, and they take about a week to hatch into aquatic nymphs or naiads which moult between six and 15 times depending on species as they grow. The nymph extends its hinged labium a toothed mouthpart similar to a lower mandible, which is sometimes termed as a "mask" as it is normally folded and held before the face that can extend forward and retract rapidly to capture prey such as mosquito larvae, tadpoles, and small fish. Emperor dragonfly, *Anax imperator*, newly emerged and still soft, holding on to its dry exuvia, and expanding its wings

Parts of a dragonfly nymph including the labial "mask" The larval stage of dragonflies lasts up to five years in large species, and between two months and three years in smaller species. When the naiad is ready to metamorphose into an adult, it stops feeding and makes its way to the surface, generally at night. It remains stationary with its head out of the water, while its respiration system adapts to breathing air, then climbs up a reed or other emergent plant, and moults ecdysis. Anchoring itself firmly in a vertical position with its claws, its skin begins to split at a weak spot behind the head. The adult dragonfly crawls out of its larval skin, the exuvia, arching backwards when all but the tip of its abdomen is free, to allow its exoskeleton to harden. Curling back upwards, it completes its emergence, swallowing air, which plumps out

its body, and pumping haemolymph into its wings, which causes them to expand to their full extent. In any one area, individuals of a particular "spring species" emerge within a few days of each other. The springtime darner *Basiaeschna janata*, for example, is suddenly very common in the spring, but disappears a few weeks later and is not seen again until the following year. By contrast, a "summer species" emerges over a period of weeks or months, later in the year. They may be seen on the wing for several months, but this may represent a whole series of individuals, with new adults hatching out as earlier ones complete their short lifespans which is an average of 7 months. Adult dragonflies have a high male-biased ratio at breeding habitats. The male-bias ratio has contributed partially to the females using different habitats to avoid male harassment. Unwanted mating is energetically costly for females because it affects the amount of time that they are able to spend foraging. Flight[ edit ] Red-veined darters *Sympetrum fonscolombii* flying "in cop" male ahead Dragonflies are powerful and agile fliers, capable of migrating across the sea, moving in any direction, and changing direction suddenly. In flight, the adult dragonfly can propel itself in six directions: This style creates more thrust, but less lift than counter-stroking; synchronised-stroking, with forewings and hindwings beating together, is used when changing direction rapidly, as it maximises thrust; and gliding, with the wings held out, is used in three situations: The wings are powered directly, unlike most families of insects, with the flight muscles attached to the wing bases. Some families appear to use special mechanisms, as for example the Libellulidae which take off rapidly, their wings beginning pointed far forward and twisted almost vertically. Dragonfly wings behave highly dynamically during flight, flexing and twisting during each beat.

**Chapter 5 : The Flight of Dragonfly Robots - MIT Technology Review**

*The Flight of the dragonfly in Front of the Sun, by Joan Miro. Abstract Expressionism, Surrealism. abstract. The Flight of the dragonfly in Front of the Sun.*

Winthrop however, eager to fulfill a personal vendetta against Gudunov, uses his considerable influence to get Colonel Alan Armstrong, who had hoped to be second in command just for the sake of it, on the crew with the intention of promoting him after the mission is on its way. The crew use a drug called "No-Die" which slows their aging process, whilst proportionately lowering their effective I. However, all does not go as planned, and soon a dangerous disease erupts among the crew. When the ship arrives at Barnard, they begin their exploration, deploying various Robot probes. David Greystroke, the ships computer engineer as well as a talented sono-video composer, creates a free fall musical and visual composition called "Flight", with Arielle Trudeau, the pilot of the Dragonfly Spaceplane, performing. A fraction of the crew, led by George, visit the double planet Rocheworld, landing a Surface Lander and Ascent Module SLAM on the water-free lobe, dubbed Roche French for rock as well as the name of the French mathematician who worked on Roche limits. After exploring Roche, they again split up, and one group journeys via the space-plane Dragonfly to the other lobe, Eau French for water, which is covered almost entirely by ocean. The crew are caught in a violent storm that causes their plane to experience a crash water-landing. The flooded propulsion systems of the space-plane are unable to provide enough thrust to break free and take off from the ocean surface. While making this journey, the space-plane attracts the attention of one of the native species of the planet: The Flouwen and the artificial intelligence aboard the space-plane establish communications and the two species begin to exchange cultural and scientific knowledge. Unfortunately for Shirley, the Flouwen morphs into rock form while thinking, leaving her stranded in the middle of the ocean and forcing a rescue operation to be mounted. The Flouwen realize the humans are travelling to the pole and warn the humans that they are approaching a period where the configuration of the star and planets of the system allow for a phenomenon where the ocean on the water lobe of Rocheworld can partially flow to the rocky lobe, due to the change in the gravitational equipotential. They try to stop the humans from continuing into this violent event by pinning the spacecraft to the ammonia-water ocean floor with ice as ballast water ice sinks in the less dense ammonia-water solution of the ocean. However, the humans realize that the interplanetary waterfall poses a threat to the crew remaining on Roche. Fortunately, the tidal stresses cause nearby dormant volcanoes to become active again. This melts an underwater glacier and floods the area with warm water, upon which the ice floats off the plane. The crew manages to get airborne and takes advantage of the changing equipotential to return to Roche. They rendezvous with the lander just as water is reaching it. The Epilogue is set years later, as a follow on mission arrives. The idea behind the solar sail is that the laser provides a small force on the sail when the sail reflects the light. This small force provides the acceleration of the spaceship. The light used in the system was an array of a thousand laser generators, which were focused through lenses and aimed at the sail. The lasers provided up to 1, terawatts of power. Two different lenses were used to magnify the laser beams. Although these accelerations are relatively small, over time they result in enormous speeds. To catch the energy, Forward used a 1,km-diameter, circular aluminum sail. The sail resembled a flattened disk with a km diameter removable center portion. When traveling to Rocheworld, the entire sail was used. When the ship needed to decelerate, the smaller sail was separated from the larger outer sail. The large sail was used as a reflecting lens, focusing light onto the smaller sail, slowing the craft. Flouwen are blob-like, happy-go-lucky aliens that spend their days surfing waves and working on difficult mathematical problems. Flouwen appear to be giant, colored jellyfish-like entities in the ammonia oceans of Eau. Like Earthly jellyfish, they are amorphous, colored blobs of jelly. Flouwen are highly intelligent, sexless, and do not appear to physically age. They are able to communicate and see in the water by means of sonar. They are also able to see outside the water by morphing their jelly bodies into crude lenses, which they use to methodically track the stars. Flouwen are also capable of morphing themselves into a hard, rock-like substance when they feel the need to think about a difficult problem for an extended period. They do this by excreting much of their body water, thereby bringing their

silica-gel-based cells closer together, which allows quicker processing of information. Flouwen can grow quite large over time. This excess bulk can be shed during a peculiar breeding ritual where large Flouwen gather in a circle and spin off pieces of themselves to create a new Flouwen. Because they are created out of indistinguishable pieces of their parents, they are born fairly intelligent. One of the aliens, Warm Amber Resonance, is said to be over five hundred Eau seasons in age. Flouwen possess mathematical abilities far exceeding our own. They do not have any concept of technology. Flouwen do not appear to have a strong social structure. They tend to treat one another equally, though mathematics proficiency appears to confer a heightened social status. Mathematics is one of the few subjects in which Flouwen show interest and concern. While younger Flouwen seem to have large amounts of free time, their elders spend long periods of time in rock form, contemplating and solving mathematical problems. As a result, the older Flouwen often hold higher social status as a result of their perceived higher knowledge in mathematics. Perhaps the actual population of the Flouwen is much larger than it appears, because there are many off working on problems. Some may never find solutions to their problems, so they will never return, thus completing their life cycle. Flouwen are also capable of splitting off sections of themselves which continue to function as Sentient beings.

Rocheworld shape[ edit ] Rocheworld is a double planet in which the two elements are close enough that they share an atmosphere. Each element is also deformed into an egg shape by the gravity of the other. The physical extension of James is the Christmas Bush. The Christmas Bush is both a modular robot and a bush robot which both communicates through and is powered by a network of laser transceivers on its body. The Christmas Bush is similar to some recursive fractal structures where the large scale shape of the robot is repeated a number of times in progressively smaller size. A main rod divides into six smaller jointed rods which also divide into six. This is repeated again and again so that the Christmas Bush can manipulate both large and small objects. The end of each rod is where the laser transceivers are located. The Christmas Bush nickname for the robot is due to that when all the rods are fully expanded the robot has a bushy texture, and is lit up like a Christmas tree. Each rod and its children rods can separate from its parent rod and each carry a certain amount of computational power. The Bush or its pieces move by crawling while experiencing acceleration due to gravity or thrust , or by flying in low gravity environments. To fly, the smallest rods work together like the cilia of single celled organisms to provide thrust in any direction. The cilia also allow James to play audio and record sound through the bush. The crew all wear a small piece of James referred to as an imp near their ear, which allows them to communicate with James and the other crew members.

Publication history[ edit ] Rocheworld was first published in slightly shorter form as a serial in Analog Science Fiction and Fact magazine in December through February

**Chapter 6 : FLIGHT OF THE DRAGONFLY**

*In The Flight of the Dragonfly in Front of the Sun, one line is enough to represent the flight of the dragonfly, almost imperceptible before the immensity of the Sun but as important as the sun itself in the eyes of the painter.*

Accepted May 6. This article has been cited by other articles in PMC. Abstract This work is a synthesis of our current understanding of the mechanics, aerodynamics and visually mediated control of dragonfly and damselfly flight, with the addition of new experimental and computational data in several key areas. New data are set in context by brief reviews covering anatomy at several scales, insect aerodynamics, neuromechanics and behaviour. We achieve a new perspective by means of a diverse range of techniques, including laser-line mapping of wing topographies, computational fluid dynamics simulations of finely detailed wing geometries, quantitative imaging using particle image velocimetry of on-wing and wake flow patterns, classical aerodynamic theory, photography in the field, infrared motion capture and multi-camera optical tracking of free flight trajectories in laboratory environments. Our comprehensive approach enables a novel synthesis of datasets and subfields that integrates many aspects of flight from the neurobiology of the compound eye, through the aeromechanical interface with the surrounding fluid, to flight performance under cruising and higher-energy behavioural modes. Odonata, flight, biomechanics, aerodynamics, prey capture, performance 1. Introduction The early diversification of insects is still under discussion but it is clear that the Odonata, including modern dragonflies Anisoptera and damselflies Zygoptera, are derived from Palaeopterans that also included the earliest fossil fliers from the Late Carboniferous. One of the Meganisoptera grew to a wingspan of approximately 70 cm and resembled a modern dragonfly in many respects, including having a broader hindwing than forewing, a broad thorax thought to contain powerful flight muscles, large mandibles and spiny legs that make Odonata such effective predators [ 1, 2 ]. Extant Odonata display impressive diversity, not least in size. The East Asian dragonfly *Nannophya pygmaea* has a wingspan of just 20 mm, whereas the forest giant damselfly, *Megaloprepus caerulatus* with a wingspan an order of magnitude higher, feeds by plucking orb weaving spiders from their webs in Central and South America. Early evolutionary history also means that Odonata can be found on every continent except Antarctica. In total, species of Odonata are known with 60 new African species described in [ 3 ]. The evolutionary success of this group despite relatively minor changes in anatomy in more than million years makes their mechanical, physiological and behavioural flight strategies worthy of investigation in the context of both biology and engineering. Adulthood is a relatively short portion of the Odonatan life cycle in comparison with their longer aquatic juvenile stage but it is plainly an important one. As adults, survivorship may be dependent on effective commuting, flight performance during hawking continuous prey seeking on the wing or darting foraging, prey recognition, targeting, interception and capture, predator evasion and, in some species, fuel economy and navigation during migration flights. Fecundity relies on successful conspecific recognition, courtship, copulation, successful oviposition and in many cases, the guarding of mates either by close patrols or tandem flights. Migration is also a big challenge for some dragonflies to exploit seasonal resources. Common green darners *Anax junius* have been observed [ 4 ] and tagged with radio transmitters [ 5 ] in the Midwest and Eastern United States. Their migratory guidance appears to be correlated with linear features in the terrain below, therefore requiring visual cues for navigation. During these flights, there will be little opportunity to forage, so flight should be tuned for the minimal cost of transport, with high-energy aerobic manoeuvres limited to evading hawks and other predators that follow convergent migration routes [ 6 ]. Such epic journeys are particularly impressive when bearing in mind these intercontinental dragonflies typically weigh on the order of 2 g. Wing musculoskeletal architecture The phylogenetic relationship between the Odonata, Ephemeroptera and the Neoptera remains controversial, and dragonflies have been crucial in efforts to determine the origin of the flight apparatus and wing folding mechanism that separate the Palaeoptera from the Neoptera. It remains a challenge to unambiguously determine the homologous structures amongst dragonflies and other Pterygota, particularly the complex muscle arrangement. Many of these muscles insert on the radial veins, giving active control over the angle of attack, camber, twist, amplitude and frequency of each of the four wings independently. Regional positional

control of the wing is enhanced further by passively prescribed motions governed by the wing architecture, including vein curvature, vein cross sections that promote torsion but resist bending [ 9 ], flexible resilin vein junctions [ 10 ], the arculus trailing edge depressor [ 11 ], the nodus [ 12 ], the pterostigma inertial regulator of wing pitch [ 13 ] and Arnold flow in the veins [ 14 ] as a regulator of wing mass [ 15 ]. The wings are hierarchical structures [ 16 ] with functionally significant detail from the cellular level to the architectural level of the wing vein patterning. There is a rich adornment of spines and hairs that are sensitive not only to the flow direction and speed but can also influence the fluid dynamics directly as air passes over the wing, encouraging the transition from laminar to turbulent flow in the boundary layer. A cross section through the leading edge of Aeshnid dragonflies reveals a T shape, composed of three rows of serrations thought to act as another type of flow control device, called turbulators [ 17 ]. At the larger scale, the attractive grid of wing veins that support the membrane are likely to act in a similar way to those in the hindwing of desert locusts [ 18 ] as a rip-stop device, protecting the wing from damage during collisions by improving fracture toughness. The planform of both the fore- and hindwings has been shown, using phylogenetically controlled geometric morphometrics methods, to correlate with long-distance migration in the Anisoptera [ 19 ]. The planform will have an influence on the aerodynamic and inertial characteristics of the wings, but the nature of these interactions is yet to be resolved fully. These corrugations define the stressed skin structure composed of girder-like veins and thin cuticle membrane. Such complex geometry has been a feature of insect wings since the Palaeozoic [ 11 , 12 , 20 ], providing sophisticated mechanical advantages for resisting longitudinal bending [ 20 – 23 ] while facilitating wing camber and torsion [ 24 ], and enabling predictable, beneficial buckling, both within the normal wing stroke cycle and in response to sudden loads [ 21 ]. The aerodynamic effect of corrugations has been investigated largely in just two dimensions, using physical [ 25 – 27 ] and computational models [ 28 ]. It has been found that the incident flow separates at the ridges, enveloping recirculating eddies that might play a role in reducing skin friction drag or modulating the lift coefficient summarized in [ 29 ]. Three-dimensional models of insect wing corrugations have been limited to extrusions of chord profiles [ 25 , 26 , 30 – 32 ] that are often based on a very limited set of measurements from a single wing of dried specimens, overlooking the consequences of spanwise variation in corrugation pattern, curvature of the ridges and valleys within the plane of the wing membrane, spanwise twist, three-dimensional aerodynamic effects, individual variation and interspecies diversity. Here, we used a scanning laser projection method to reconstruct three-dimensional wing geometries by photographing cross sections illuminated by a laser line generator and traversing subjects through a calibrated plane in millimetre intervals using a micromanipulator. Corrugation pattern and amplitude vary greatly along the span and their contribution to aerodynamic performance was evaluated by comparing the full-fidelity model with artificial wing shapes.

### Chapter 7 : Title: The Flight of the Dragonfly

*the dragonfly takes off in flight. only a few days only a few days our life cannot last forever we must fly as if never we will ever fly again any moment is the end.*

### Chapter 8 : The Flight of the Dragonfly in Front of the Sun, by Joan Miro

*The Timescape edition of "Flight of the DragonFly" was about , words of it. The Baen edition of "Flight of the DragonFly" was about , words of it. The version is about , words and marked "At Last The Complete Story!".*

### Chapter 9 : The Flight of the dragonfly in Front of the Sun, - Joan Miro - calendrierdelascience.com

*Flight of the Dragonfly composed and performed by Kristie Vosburg and Sarah Frey. v2.*