Deception at its height

The wily Cuckoo finds ways to evade those that see through its disguise, says s ananthanarayanan

Common Cuckoo.

THE female Cuckoo, like all mothers, wishes a fine upbringing for her children but, unlike human mothers, wants none of the drudgery. She builds no nest, does not brood and hatch her eggs and she does not make the great effort it takes to feed the young — she just lays her egg in the nest of another bird and leaves it all to the foster mother. And to help her to carry out this scheme she adapts her eggs to resemble those of other birds and also her own looks so that she can be mistaken, as if she were not a Cuckoo. Scientists at the University of Cambridge have found that she goes one further — even when she is being found out, some of her sisters artfully do not don the disguise and keep other birds guessing!

Dr Rose Thorogood.

The Cuckoo's method is to lay one egg among the other eggs already there in another bird's nest. The other bird is usually the Reed Warbler or a Dunnock and the egg the Cuckoo lays is deceptively like the other eggs. In fact, there are seven different egg types that Cuckoos lay and the bird that lays one kind will choose a host nest of just the right kind so that the egg stays undetected and cared for. The fledgling is energetic and ungrateful and pushes the foster sibling eggs and chicks out of the nest, to be the sole recipient of the mother's attention and is none the poorer for being in a foster home.

But how does the mother Cuckoo know how to choose the right nest? The answer is that she was herself hatched among the similar looking eggs and finding the right nest again to lay her own egg is really a homecoming for her!

There is the question, of course, of why the foster mother bird does not catch on to the trick being played on her. Well there has been adaptation for this as well. In some birds where there is brood parasitism, the parasite babies have evolved cries and "mouth gape" patterns, or colouration of the open mouths that both resemble the foster mother's natural young and also strongly propel the mother to feeding behaviour. It seems the foster mother's genetic programme to feed whatever there is in her nest is so strong that the deception is effective. Genetics has been successful in generating adapting variations among Cuckoos but not so among host birds — one more instance of parasite species not necessarily repaying the victim species in an obvious way.

But getting back to the colouration of the eggs — how is it that female Cuckoos always lay the kind of eggs they were themselves hatched from?

Sparrowhawk.

Cuckoo chick being fed by Reed Warbler.

Does the egg variety of the Cuckoo mate not have an effect? While a female Cuckoo has no way of knowing the egg variety of a male Cuckoo before mating, it is also a fact that the choice of mate is really random. The reason for consistent egg colouration seems to lie in the nature of the Cuckoo chromosome, or the genetic material that that the male and female contribute to the egg. In mammals, like in humans, the females have two chromosomes of the same kind – "YY".

But the males have one "Y" and one "X" and they are "XY". The offspring can thus either get a "Y" from both parents and end up as "YY" and female, or it may get the father's "X" chromosome and end up as "XY". But in birds, it is the females who have the different kinds of chromosomes. The two kinds are called "Z" and "W" — females are "ZW" and males are "ZZ". Female offspring which are "ZW" have then received the "W" chromosome from the mother and the colouring genes that this chromosome possibly carries is passed on from the mother — the father does not influence egg colouration.

Cuckoo egg among those of the Great Reed Warbler.

Stealth and disguise

While this is the way the Cuckoo egg prospers once it is laid, the female has first to sneak up to the host bird's nest and lay that egg. It seems that the marked resemblance of the Cuckoo, in size, shape and plumage to especially the Sparrowhawk, a bird of prey, has a role to play in this. The resemblance of one species to another, more powerful and fearsome species, for protection from enemies, is not uncommon in nature. Conversely, species that prey on other creatures may evolve to resemble harmless species, to more easily get within striking range of their victims. The Cuckoo and Sparrowhawk could be such a mutually benefiting pair. The dull grey colour, which merges with foliage, could also help conceal the Hawk for the attack, the Cuckoo to induce the host bird to leave the nest unguarded.

Studies have shown that many smaller birds do associate Cuckoos with Sparrowhawks. Feeders were hung up by Cambridge University scientists in a study published in 2008 to attract Great Tits and Blue Tits. When stuffed and mounted Cuckoos or Sparrowhawks were placed near the feeders, it was seen that that the attendance dropped, of both kinds of Tits. But this did not happen if models of other birds, like the Collared Dove or the Teal were presented.

The alarm response to Cuckoos was found to rise from resemblance to the Hawk — if the underparts of the Cuckoo model were not "barred", like the Hawk's, they were treated as if they were Doves! Nor was it only the underparts that caused the alarm, for models of Hawks with white underparts also evoked fear, while Doves with barred underparts did not. And as the Teal is not at risk of parasite egg laying by the Cuckoo, the fear was because she was mistaken for a Hawk!

But the deception does not last long and the Reed Warbler, a popular host parasitised by the Cuckoo, had developed a defence. When a female Cuckoo is spotted, the Reed Warblers attack by "mobbing" the bird to reduce the chance that it should lay in one of their nests. As we have seen, the Cuckoo has evolved to be grey and Hawk-like to reduce the chance of being mobbed. And still there are some Cuckoos that are bright and brownish-red. Such alternate colours are rare among birds, but are seen among parasitic Cuckoo species. The current work of the Cambridge group, reported in the journal *Science*, indicates that this is a second-order ruse the Cuckoo had developed.

The study shows that the "mobbing" behaviour of Reed Warblers is strongly influenced by the behaviour of their neighbours — if they find that a grey, Cuckoo-like bird has been mobbed, they are likely attack another grey tone Cuckoo. If there are a number of grey tone Cuckoos, the flock of Warblers would all go for the grey tone variety, allowing the red-brown kind to slip in and lay eggs in the nests! This is then an instance of a species developing alternate forms, called *polymorphism*, to overcome limitations of mimicking features alone.

"… Our research shows that individuals assess disguises not only from personal experience but also by observing others. However, because their learning is so specific, this social learning then selects for alternative Cuckoo disguises and the arms race continues," says Dr Rose Thorogood, co-author of the paper.

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The rover has landed

After a 352-million mile journey, *Curiosity* may tell us if life ever existed on Mars, writes steve connor

AFTER 36 weeks flying 352 million miles through the interplanetary void between earth and Mars, *Curiosity* ended its journey with a perfect landing on Monday morning. Bang on schedule, the one-tonne rover touched down safely on the dust-strewn surface of the Red Planet. The last leg of the flight, dubbed the "seven minutes of terror", saw its mother spacecraft deploy parachutes, a heat shield, retrorockets and some nifty S-shaped turns to slow it down from the breakneck speed of 13,200 mph to land its six-wheeled baby with a gentle bump.

Now a space probe the size of a family car — the biggest to sit on the surface of another planet – awaits orders to begin one of the most thrilling assignments in the history of space exploration. Its bank of 10 scientific instruments are the most sophisticated of any roving vehicle to land on Mars and are designed to find out whether our neighbouring planet was ever habitable. In short, *Curiosity* could answer one of the biggest questions of science: was there ever life on Mars?

The $2.5-billion mission was literally hanging by a thread just a few moments before touchdown as the six-wheeled *Curiosity* was lowered on three nylon lines from its mother spacecraft hovering about 20 fee overhead. National Aeronautics and Space Administration scientists had taken a huge gamble in using a novel kind of landing device, which they called the "sky crane", because other tried-and-tested methods, such as giant, inflatable airbags to cushion the final bump, would not work with a payload this heavy. The sense of tension, and then relief, was evident within mission control at Nasa's Jet Propulsion Laboratory in Pasadena, California, as the sky crane delivered its precision cargo. Loud cheers broke the tense silence after Al Chen, a JPL engineer, announced, "Touchdown confirmed."

John Holdren, President Obama's chief scientist, immediately trumpeted the American success, which had been likened in its technological precision to driving a golf ball from a tee in Los Angeles to a green in St Andrew's, and still managing to get a hole in one. "If anybody has been harbouring doubts about the status of US leadership in space, well there's a one-tonne, automobile-size piece of American ingenuity, and it's sitting on the surface of Mars right now," Dr Holdren said.

The scientific instruments on board *Curiosity* are 15 times as large as the science payloads on the two previous Mars rovers, *Spirit* and *Opportunity*. Some of these, such as the laser-firing spectrometer for checking the chemical composition of rocks from a distance, have never been used before. Nasa said that the rover, which is powered by plutonium batteries so that it does not have to rely on solar panels, will use a drill and scoop at the end of its robotic arm to gather soil and rock samples that will be analysed by an onboard laboratory that will beam the results back to earth. The nuclear-powered *Curiosity* is designed to operate for two years but Nasa scientists are quietly confident that it will still be collecting data and sending it back to earth in 10 or even 20 years' time.

Curiosity was put down in one of the most enigmatic regions of Mars, a vast depression called the Gale Crater where it will spend much of its time exploring the internal mountain where the geological history of Mars? can be explored. Observations from orbiting spacecraft show that the lower layers of this mountain include clay and sulphate minerals, indicating that it has been exposed to liquid water, one of the essential preconditions for life. Other scientific expeditions on Mars have already shown that there was water on the planet. *Curiosity* should be able to discover whether this part of Mars was, indeed, habitable in the past, or even whether it could support future manned visits, said Nasa administrator Charles Bolden. "*Curiosity*, the most sophisticated rover ever built, will seek to answer age-old questions about whether life ever existed on Mars, or if the planet can sustain life in the future," he said.

Scott Maxell.

Driving a car on Mars sounds like the ultimate Jeremy Clarkson experience, but in fact it requires a geek-like understanding of computer programming. Scott Maxell usually drives a Toyota Prius, but he also has the enviable job of driving probably the most expensive wheeled vehicle in history – *Curiosity*. He is one of about a dozen Nasa engineers charged with the task of steering this enterprise over the surface of the Red Planet from mission control in Pasadena, more than 100 million miles away. He said, "It's a priceless national asset that happens to be sitting on the surface of another planet.

You better take that damn seriously." The 41-year-old has already "driven" 2003's twin Mars explorers *Spirit* and *Opportunity*. As radio signals take from four to 20 minutes to reach Mars, each manoeuvre is painstakingly worked out the previous day and sent as a complete batch of commands. "It's as if we're e-mailing the rover its To Do list for the entire day," Maxwell said. "You're essentially driving a robot with a keyboard 100 million miles away. If anything goes wrong, there's no one there to hit the panic switch."

The Independent, London

Organisms in combat

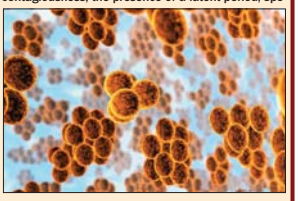
With the development of genetics, the conception of the infectious agent has now become considerably extended, writes tapan kumar maitra

THE term "infection" (*L infectio*, to infect) signifies the sum of biological processes that take place in the macro-organism upon the penetration of pathogenic micro-organisms into it, independent of whether the penetration will entail the development of an obvious or a latent disease or whether the macro-organism will only become a temporary carrier of the causative agent.

The historically developed interaction of the susceptible human organism and the pathogenic micro-organism in certain conditions of the external and social environment, which gives rise to an obvious or latent pathological process, is called the infectious process.

From the biological point of view, the infectious process is a kind of parasitism in which two live organisms adapted to different environmental effects enter into combat. Infectious disease designates one of the extreme degrees of manifestation of the infectious process. Infectious diseases are considered to be phenomena, inclusive of biological and social factors. Thus, for example, the mechanisms of transmitting infectious diseases, their severity and outcome are provided for mainly by social conditions.

Infectious diseases differ from other ailments in that these are caused by live causative agents of a plant and animal origin and are characterised by contagiousness, the presence of a latent period, specific reactions of the body to the causative agent and production of immunity.



Computer artwork of a multitude of spherical (cocci) bacteria. It is considered that cocci are the most ancient micro-organisms. They have been found in limestones of the Proterozoic era and in coal rock of the Paleozoic era. In the process of evolution some species of coccal forms acquired the ability of a parasitic way of life. The appearance of pathogenic cocci is believed to date from the Permian period. In the deposits of this period of the earth, great changes were discovered in the bones of reptiles. It is possible that some of these changes were the consequence of diseases caused by infectious species of cocci.

With the development of genetics, the conception of the infectious agent has now become considerably extended. In many species of pathogenic agents the infectious properties are possessed by high-molecular DNA containing cytoplasmic structures (*plasmids*) as well as by the nucleic acids of tumour (*oncogenic*) viruses, which are not organisms but are capable of accomplishing genetic information inherent in the corresponding viruses. It has thus been proved that besides diseases in which the infectious process is caused by living agents, there are infections occurring on a molecular level that are characterised by the ability to be transmitted not only through the external environment but from parents to the offspring.

The origin of pathogenic microbes and infectious diseases goes back to ancient times. As a result of a long-term evolutionary process, parasitic species of micro-organisms were formed that were capable of causing various infectious diseases in humans under certain conditions.

It is considered that *cocci* are the most ancient micro-organisms. They have been found in limestones of the Proterozoic era and in coal rock of the Paleozoic era. In the process of evolution some species of coccal forms acquired the ability of a parasitic way of life. The appearance of pathogenic cocci is believed to date from the Permian period. In the deposits of this period of the earth, great changes were discovered in the bones of reptiles. It is possible that some of these changes were the consequence of diseases caused by infectious species of cocci.

It is more likely that from the aquatic saprophytic and free-living *vibrios*, pathogenic vibrios were formed. Between the aquatic and cholera vibrios there are intermediate (*paracholera*) forms.

The origin of Mycobacterium tuberculosis can also be traced back to ancient times. Over a long period, tuberculosis as well as its causative agents have undergone considerable evolution. The fact that the known species and variants of Mycobacterium are parasites of different animals not closely related to each other — warm-blooded (birds, rodents, cattle, humans) and cold-blooded (fish, snakes, turtles, frogs) — suggests the antiquity of mycobacteria.

Pathogenic micro-organisms could have originated due to the adaptation to the human body of organisms parasitic on domestic and synanthropic (living near the homes of man) animals (causative agents of typhus fever, enteric fever, smallpox) or on wild animals (causative agents of relapsing fever, yellow fever, skin leishmaniases).

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