The problem of life's origin remains one of the great outstanding challenges to science. Ever since Charles Darwin mused about a "warm little pond" incubating life beneath sunny primeval skies, scientists have speculated about the exact location of this transforming event. Nearly a century and a half later, we remain almost completely ignorant of the physical processes that led from a nonliving chemical mixture to the first autonomous organism.

Some progress at least has been made on tracking down where and when life first established itself on Earth. Fossil evidence suggests that the biological record extends back at least 3.5 billion years, pointing to a still earlier origin. But this presents a problem. The cratering record of the moon implies that Earth was subjected to intense bombardment by large comets and asteroids over an extended duration until about 3.8 billion years ago. The largest of these impacts would have released enough energy to swathe the planet in incandescent rock vapour, boiling the oceans and sending sterilising heat pulses a kilometre into the exposed crust. This unpromising setting - hardly a secure one for warm little ponds - has prompted some astrobiologists to conjecture that life began somewhere else and came to Earth ready-made. Favourite among extra-terrestrial originating locations is the planet Mars.

Mars is the most Earth-like of our neighbouring planets and enjoyed a number of advantages during the early history of the solar system. Though a freeze-dried desert today, Mars was warm and wet before about 3.6 billion years ago. Being a smaller planet, it cooled more quickly, making it suitable for life sooner than Earth. Gene sequencing indicates that the oldest and deepest branches of the tree of life are occupied by hyperthermophilic archaea and bacteria, hinting that the earliest life forms dwelt deep beneath the oceans near volcanic vents, or even kilometres underground in the crust itself.

The deep subsurface zone remains populated on Earth today, and probably offers the most promising location on Mars for finding any extant life. It would have become cool enough for hyperthermophilic microbial life on Mars perhaps as long ago as 4.5 billion years, when the Earth's crust was still sizzling. Ensnosed in this Hadean niche, shielded by a kilometre of two or rock, Martian life could have withstood the ferocious early bombardment that afflicted Mars just as it did Earth.

Plausible though this exo-genesis theory may seem, it leaves the problem of how life spread from Mars to Earth. Fortunately, a mechanism readily suggests itself. Earth and Mars are known to trade rocks on an ongoing basis - a couple of dozen Mars meteorites have so far been identified in terrestrial collections. The mode of delivery is the very same cosmic bombardment that so imperilled early life. Comets and asteroids can hit Mars hard enough to splatter rocks across the solar system, and computer simulations show that a few per cent end up on Earth eventually. Cocooned within a rock a metre or two across, a microbe would be spared the worst hazards of outer space. The cold vacuum of space is not too problematic, and can even serve to preserve microbial spores. More importantly, the rock would shield the microbes therein from solar ultra-violet rays, solar flares and all but the highest energy cosmic rays.

Studies by Curt Mileikowsky, Jay Melosh and their collaborators indicate sojourn times of millions of years in such conditions before the accumulated radiation damage in any embedded microbes becomes irreversible. That is easily long enough for some fraction of ejected Mars rocks to land on Earth. Given a favourable trajectory, an incoming Mars rock would not burn up, or indeed even heat up much in the interior, on entry into Earth's atmosphere.

These considerations add up to a significant probability that, had life got going on Mars first, it would have been transported to Earth on a continuing basis over hundreds of millions of years, enabling it to become established as soon as terrestrial conditions permitted - say, 3.8 billion years ago. The same scenario could work in reverse, of course, though Earth's deeper gravity well and more torrid early history makes it less plausible. Calculations indicate that the transportation of viable microbes much farther afield than near-neighbour planets is exceedingly unlikely, so the above mechanism must not be regarded as giving support to the old panspermia theory of Arrhenius.

If Mars was indeed the cradle of terrestrial life, it adds urgency to the search for traces of life on the red planet today. Because Mars has not been subjected to severe tectonic processing, the record of
The fact that Earth and Mars are clearly not biologically isolated implies that the discovery of past or extant life on Mars will not provide us with a much sought-after second genesis. Rather, Martian and terrestrial organisms would occupy different branches on the same tree of life. Without a second sample of life – another bio-system that started from life's origin was a freak chemical event, unique in the observable cosmos, or an automatic product of intrinsically bio-friendly laws of nature.

References

Fluconazole is a triazole antifungal agent.


CONTRAINDICATIONS: 1. Hypersensitivity to fluconazole, to related azole compounds or excipients. Concomitant use with cisapride or terfenadine.

PRECAUTIONS: PREGNANCY (Category D): lactation, has been found in breast milk at concentrations similar to plasma, hence its use in nursing mothers is not recommended; immunocompromised patients who develop rashes; allow for salt content and volume of the infusion solution; patients who develop abnormal liver function tests should be monitored for the development of more severe hepatitis. Injury and Diflucan should be discontinued if clinical signs and symptoms consistent with liver disease develop that may be attributable to fluconazole.

Some azoles, including fluconazole, have been associated with prolongation of the QT interval on the electrocardiogram. During post-marketing surveillance, there have been very rare cases of QT prolongation and torsade de pointes in patients taking fluconazole. These reports included seriously ill patients with multiple confounding risk factors, such as structural heart disease, electrolyte abnormalities and concomitant medications that may have been contributory. Fluconazole should be administered with caution to patients with these potentially proarrhythmic conditions.

Drug Interactions: Oral contraceptives; warfarin; sulphasymyureas; hydrochlorothiazide; phenytoin; theophylline; astemizole; cyclosporin; rifabutin; rifampicin; tacrolimus; zidovudine; short-acting benzodiazepines.

ADVERSE REACTIONS: Headache; nausea; vomiting; abdominal pain; diarrhoea; skin rash; acne; mild transient elevations in hepatic transaminases; clinical hepatitis; cholestasis; fulminant hepatic failure; anaphylaxis; rare cases of leukopenia and thrombocytopenia (causal relationship not established). QT prolongation, torsade de pointes.

DOSAGE & ADMINISTRATION: Normally administered orally; if not possible, by intravenous infusion (not exceeding 200 mg/hour). Base daily dose on the infecting organism and the patient's response to therapy. Continue until clinical evidence or laboratory tests indicate that active fungal infection has subsided. Patients with AIDS and cryptococcal meningitis or recurrent oropharyngeal candidiasis often require maintenance therapy to prevent relapse. Diflucan IV has been used safely for up to 14 days. Diflucan intravenous infusion is compatible with Ringer's solution: normal saline. Avoid mixing with any other drug prior to infusion. Adults: Cryptococcal meningitis: 400 mg on day 1, then 200–400 mg daily. Continue 10–12 weeks after CSF becomes culture negative. Infants not responding to treatment for up to 60 days are unlikely to respond to Diflucan. Prevention of relapse of cryptococcal meningitis: 100–200 mg daily. Oropharyngeal candidiasis: 100 mg on day 1, then 50 mg daily for 2–3 weeks. Oesophageal candidiasis: 200 mg on day 1, then 100 mg daily for 2–3 weeks and in severe cases for 2 weeks following resolution of symptoms. Secondary prophylaxis against oropharyngeal candidiasis: 150 mg as a single dose once weekly. Severe and life-threatening candida infections: 400 mg on day 1, then 200–400 mg daily for at least 4 weeks and for at least 2 weeks following resolution of symptoms. Vaginal candidiasis when topical therapy has failed: 150 mg as a single oral dose. Children: mucosal candidiasis: 3 mg/kg daily. A loading dose of 6 mg/kg may be used on day 1. Systemic candidiasis and cryptococcal infection: 6–12 mg/kg daily, impaired renal function in adults and children: reduce dose in accordance with the guidelines given for adults. Children below 4 weeks of age: neonates excrete fluconazole slowly. Weeks 0–2: same mg/kg dosing as in older children at 72-hour intervals. Weeks 2–4: same dose every 48 hours.

PRESENTATION: Hard Gelatin Capsules: 50 mg, 100 mg, 200 mg – packs of 1. 150 mg – packs of 28. 225 mg – packs of 28. 250 mg – packs of 28. 500 mg – packs of 28. Oral fluid suspension: 35 mL bottle containing 50 mg/5 mL of orange flavoured suspension when reconstituted. Solution for Injection: 2 mg/mL in sodium chloride solution: 50 mL and 100 mL vials.

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