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# From Kathmandu to Mars: Lujendra Ojha and the Science of a Distant World

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**Lujendra Ojha became internationally known because, as an undergraduate, he noticed dark seasonal streaks on Mars that more experienced researchers had not fully recognised. The observation eventually led to some of the most widely discussed research of the 2010s on recurring slope lineae, hydrated salts and the possibility of present-day brines on the Martian surface. But the headline “Nepali scientist finds water on Mars” was always too simple. Ojha’s real scientific story is more interesting: careful observation opened a question, new evidence changed the interpretation, and the**

**researcher who helped launch the debate went on to build a broader career in planetary geophysics.**

That distinction matters because frontier science rarely ends with one discovery announcement. Mars research is full of competing explanations that become stronger or weaker as spacecraft collect better data. Ojha's contribution was not delivering a final answer about liquid water. It was identifying and characterising an active process on another planet well enough that the scientific community had to rethink what modern Martian slopes were doing.

Today, Ojha is an associate professor in Earth and Planetary Sciences at Rutgers University, where his research extends far beyond the features that first made him famous. His work includes Mars geophysics, terrestrial-planet evolution, habitability, exoplanets and questions about subsurface environments on worlds such as Europa. The student who noticed a pattern in an image became a scientist studying how entire planets work.

## **From Nepal to the United States**

Ojha was born in Nepal and later moved into the American education system, eventually studying geophysics at the University of Arizona. His path placed him inside one of the world's leading centres for planetary imaging because Arizona was deeply involved with NASA's Mars Reconnaissance Orbiter.

For a student interested in planets, this meant access to real spacecraft data rather than only textbook examples. Mars was not an abstract object in the sky. It was a surface that could be studied through images detailed enough to reveal changes across seasons.

Undergraduate research often consists of careful technical work that appears routine. Ojha's story shows how routine work can become discovery when someone notices that a pattern does not fit what was expected.

## **The HiRISE Camera**

NASA's Mars Reconnaissance Orbiter carries the High Resolution Imaging Science Experiment, or HiRISE, capable of photographing the Martian surface at extraordinary detail. The instrument transformed planetary geology by allowing scientists to study features at scales impossible from earlier missions.

Ojha worked with images produced by the HiRISE team under planetary scientist Alfred McEwen. His task required comparing terrain across time and looking for changes that might reveal active geological processes.

This kind of work rewards patience more than drama. The spacecraft collects the data, but interpretation still depends on human attention.

## **The Dark Streaks**

In 2010, Ojha noticed narrow dark features appearing on steep Martian slopes. They seemed to lengthen during warmer seasons and fade later. The features were eventually named recurring slope lineae, or RSL.

The behaviour was scientifically provocative because Mars was generally understood as cold and extremely dry at the surface. Seasonal activity suggested that something was moving repeatedly rather than representing a one-time ancient feature.

Gravity clearly played a role because the streaks extended downhill. The harder question was what material was moving and why temperature appeared to matter.

## **Why Water Became the Obvious Question**

Mars contains abundant geological evidence that liquid water once shaped its surface. Ancient valleys, lake basins and minerals show that the planet was very different billions of years ago. The central modern question is whether any liquid water remains active today.

Present-day conditions make stable surface water difficult. Low atmospheric pressure causes liquid water to boil or evaporate rapidly, while cold temperatures promote freezing.

Salty water changes the equation slightly because dissolved salts can lower the freezing point. This made brines one plausible explanation for the seasonal streaks.

## **The First Papers**

Ojha and collaborators published research describing the RSL and exploring mechanisms that might create them. The observations quickly attracted attention because any evidence for current liquid water on Mars has implications for geology, planetary protection and the search for environments capable of supporting life.

The scientific language remained cautious. Researchers were not watching streams flow directly. They were inferring processes from changing surface features.

Popular media understandably compressed this uncertainty into more dramatic headlines, creating a gap between what the papers showed and what many readers thought had been proven.

## **The 2015 Hydrated-Salt Study**

Ojha later led a study using spectral data from the Compact Reconnaissance Imaging Spectrometer for Mars, or CRISM, that detected hydrated salts associated with several RSL locations. NASA announced the results in September 2015 with major global attention.

Hydrated salts contain water within their mineral structure and can be consistent with the presence of brines. Their association with active RSL sites strengthened the argument that water was involved somehow in the process.

Ojha, then at Georgia Tech, became the public face of the research because he was the lead author and because his undergraduate observation had begun the chain of inquiry.

## **“Liquid Water on Mars”**

The 2015 announcement was widely translated into the statement that NASA had confirmed flowing liquid water on present-day Mars. That interpretation was understandable but too strong. The data did not show open streams or pools.

What the researchers had detected were salts whose hydration state and location suggested a connection with seasonal slope activity. The exact amount and source of water remained uncertain.

This distinction is crucial because scientific evidence operates in degrees. “Consistent with” is not the same phrase as “directly observed.”

## **Science Changes Its Mind**

Later studies complicated the wet interpretation of recurring slope lineae. Some researchers found that the features behaved more like dry granular flows moving down slopes once they reached particular angles of repose. The role of water began to look smaller than early headlines suggested.

This does not invalidate Ojha's discovery or the hydrated-salt detection. It changes the mechanism scientists consider most likely for many sites.

Science advances precisely through this process. A hypothesis gains attention because it explains available evidence, then new measurements reveal where the explanation is incomplete.

## **Why Revision Is a Strength**

Public culture often treats changing scientific conclusions as evidence that scientists were wrong. In reality, revision is one of science's strongest features. Claims remain open to better data.

Ojha's Mars story is particularly instructive because his own career continued as the interpretation evolved. He was not required to defend the first explanation as a personal identity.

The object of research was Mars, not the preservation of a headline.

## **The Real Importance of RSL**

Even if many recurring slope lineae are driven mainly by dry processes, they remain evidence that the Martian surface is active today. Mars is not simply a fossilised world preserving events from billions of years ago.

Dust, sand, frost, salts, temperature and gravity continue modifying the landscape. Understanding those processes helps scientists reconstruct the planet's current climate and surface conditions.

Ojha's contribution therefore remains significant even as the water interpretation becomes more nuanced.

## **From Undergraduate Discovery to PhD**

Ojha completed his undergraduate degree in geophysics at the University of Arizona in 2012 and continued into doctoral work in planetary science at Georgia Tech, earning his PhD in 2016. The transition moved him from one discovery into a broader research career.

Graduate training requires a different kind of independence. A student must learn to design questions, build models, analyse uncertainty and communicate results beyond one interesting observation.

For Ojha, Mars remained important, but the scientific toolkit expanded.

## **Planetary Geophysics**

Geophysics uses physical principles to understand structures and processes that cannot always be seen directly. On Earth, scientists may study seismic waves, gravity or magnetic fields to infer what lies below the surface. Planetary geophysics applies similar methods to worlds where direct sampling is limited.

This is especially powerful in space science because researchers often have only remote measurements. They cannot drill deeply into Mars or Europa whenever a question arises.

Models therefore connect limited observations with possible interior structures and geological histories.

## **Johns Hopkins and Postdoctoral Research**

After graduate school, Ojha worked at Johns Hopkins University in research and postdoctoral roles before joining Rutgers University in 2019. These years allowed him to broaden his research beyond the original RSL question.

Postdoctoral science is often where researchers establish a distinctive programme independent of doctoral advisers. Publication, grant writing and collaboration become central.

By the time Ojha joined the Rutgers faculty, he was building a research identity around planetary evolution and habitability rather than one famous Mars feature.

## **Rutgers University**

Rutgers currently lists Ojha as an associate professor in Earth and Planetary Sciences, with research interests in planetary science and geophysics. His group uses remote sensing, numerical models, laboratory simulation and terrestrial field work.

This diversity reflects a basic challenge of planetary research: no single method can answer every question. Images show surface form, spectroscopy reveals composition, geophysics constrains interiors and laboratory experiments test whether proposed mechanisms are physically plausible.

Strong planetary science combines those methods rather than treating spacecraft imagery as self-explanatory.

## **Studying Mars Beyond RSL**

Ojha's later work includes Mars interior processes, impacts, magnetic signatures and the geological history of the planet. These questions connect surface observations to deeper structures.

Mars is especially useful because it preserves evidence that Earth's active geology often destroys. Ancient crust and impact structures can retain information about early planetary evolution.

Understanding Mars therefore helps scientists ask broader questions about why neighbouring terrestrial planets developed so differently.

## **Habitability Is Not the Same as Life**

Planetary scientists frequently use the word “habitability,” which is easily misunderstood. A habitable environment is one where conditions may allow life as we know it; it is not evidence that life exists there.

Ojha's work on water and planetary environments contributes to this distinction. Finding conditions compatible with life changes where scientists should look, but it does not answer whether biology ever emerged.

The search for life requires several layers of evidence beyond geology.

## **Europa and Hidden Oceans**

Ojha's recent research also extends to Europa, Jupiter's icy moon, which is believed to contain a global ocean beneath its frozen surface. Europa is one of the most compelling places in the solar

system for habitability research because liquid water may exist in enormous quantities underground.

A 2026 research output involving Ojha examined how directly Europa's deep subsurface ocean may exchange material with shallower environments. Such questions matter because future missions can access the surface far more easily than the deep ocean.

If material exchange is limited, interpreting surface chemistry becomes more complicated.

## **Exoplanets and Comparative Planetology**

Ojha has also expanded into work related to planets beyond the solar system. Thousands of exoplanets are now known, but most cannot be observed in detailed images the way Mars can.

Scientists therefore use physics learned from nearby planets to interpret distant ones. Mars, Venus, Earth and icy moons become laboratories for understanding possible planetary behaviours elsewhere.

This comparative approach turns planetary science into a much larger question: why do some worlds remain geologically active, retain water or support stable climates while others do not?

## **The Role of Models**

Public discussion of space science often focuses on spectacular images, but much of the real work happens through models. Researchers use equations and computation to test whether proposed processes can reproduce observed data.

A model does not prove what happened. It shows whether an explanation is physically possible and what additional evidence should be expected if the explanation is correct.

Ojha's geophysical research increasingly operates in this less visible but essential part of planetary science.

## **The Nepali Scientist Narrative**

In Nepal, Ojha became famous through a simplified national-pride story: a Nepali scientist discovered water on Mars. The excitement was understandable because Nepal rarely sees its scientists become global news.

But the simplified version can actually understate his achievement. Science is not a competition in which one person "finds" a planetary truth and owns it permanently.

Ojha helped open a major research question, contributed key observations and then continued building a serious academic career as that question evolved.

## **Knowledge as a Diaspora Contribution**

Nepal's diaspora is usually measured through remittances because money transfers are visible in national accounts. Scientists, academics and engineers contribute differently.

They produce papers, train students, participate in international projects and connect Nepal indirectly to global knowledge networks. These effects are difficult to count but culturally important.

Ojha's career shows a form of diaspora achievement that does not fit conventional economic narratives.

## **What Nepal Can Learn from His Path**

The lesson is not simply that talented Nepalis can succeed abroad. That is already obvious. The more useful lesson concerns research culture.

Ojha's breakthrough began because an undergraduate was given access to real scientific data, expert mentorship and enough intellectual freedom to notice something unexpected. Research institutions create discovery by allowing young people to participate before they are famous or senior.

Nepal's universities can learn from this model even without NASA-scale budgets. Students need genuine research problems, not only

examination syllabi.

## **Attention as a Scientific Skill**

Scientific breakthroughs are often narrated as moments of genius. Ojha's origin story highlights a less glamorous skill: sustained attention.

The spacecraft had already collected the images. Thousands of people could potentially have looked at them. The scientific value emerged because one student noticed a recurring pattern and treated it as a question rather than visual noise.

Observation is not passive. It is trained curiosity.

## **Beyond Mars**

By 2026, Ojha's career could no longer be summarised accurately by one Mars discovery. His research had expanded across planetary interiors, magnetic and gravity signatures, impact processes, Europa and exoplanetary questions.

This widening is the normal trajectory of a scientist. Early discoveries create reputation, but long careers are built by asking new questions rather than protecting old ones.

The most important development may therefore be that the phrase "Mars scientist" is becoming too narrow for him.

## **The Value of an Unfinished Answer**

Recurring slope lineae remain a useful symbol of Ojha's career because they demonstrate what science actually looks like. A puzzling observation appears, a compelling explanation gains support and later work reveals greater complexity.

There is no embarrassment in the unfinished answer. The unfinished answer is what creates research.

## **Why Planetary Science Is Collaborative**

Popular science stories often reduce discoveries to one person, but planetary research is intensely collaborative. Spacecraft require engineers, instrument teams, mission planners, data scientists and researchers spread across universities and government agencies.

Ojha's work on recurring slope lineae emerged inside this larger system. His observation mattered because other scientists could test it with additional images, spectroscopy and physical modelling.

The most accurate story therefore preserves both individual contribution and collective verification. Science advances when one person notices something and many others try to prove that person wrong.

## **The Importance of Open Data**

Planetary science benefits from large archives of mission data that researchers can revisit repeatedly. A spacecraft may collect an image for one purpose, only for another scientist years later to identify a completely different feature inside it.

This creates a powerful model for scientific infrastructure. Data becomes more valuable when it remains accessible to students and researchers beyond the original mission team.

Ojha's undergraduate discovery is a strong argument for giving young scientists genuine access to high-quality datasets rather than treating important research as something reserved for senior academics.

## **From Headlines to Teaching**

A faculty career adds another dimension to scientific influence. Professors are responsible not only for publishing research but for training students who may ask questions the professor would never have considered.

Ojha's laboratory at Rutgers places him in the same mentoring position that once allowed him to work with Mars images as an undergraduate. The cycle of discovery depends on experienced scientists creating opportunities for inexperienced ones.

This may ultimately be one of the most important ways his career contributes to science: not only through what he personally discovers, but through the researchers he helps develop.

## **Why Mars Still Matters**

Mars remains scientifically compelling because it is both familiar and alien. It has seasons, polar ice, volcanoes and ancient river systems, yet its modern surface is hostile to life as we know it.

Understanding how Mars lost much of its atmosphere and surface water helps scientists ask why Earth remained habitable.

Planetary science is therefore partly comparative Earth science.

Ojha's early question about dark slope features sits inside this much larger inquiry into how rocky planets evolve.

## **Science Communication and the Headline Problem**

Ojha's Mars work also demonstrates how difficult science communication becomes when nuanced evidence meets a news cycle searching for certainty. "Hydrated salts associated with recurring slope lineae" is scientifically precise but difficult to communicate. "Water found on Mars" is memorable and much less accurate.

Researchers have to navigate this gap carefully because public excitement is valuable, especially for space science, but exaggerated claims eventually damage trust when later studies introduce uncertainty.

Ojha's story is therefore useful as an example of why scientists and journalists both need to preserve the difference between evidence, interpretation and conclusion.

## **The Value of Nepali Scientific Role Models**

Nepal produces far fewer internationally visible scientists than athletes, entertainers or political figures, which makes careers like Ojha's disproportionately important to young students. A teenager interested in physics or geology needs examples showing that research can become a serious life rather than only an academic subject.

Role models do not solve shortages in laboratories, funding or faculty positions, but they expand what students imagine as possible. Visibility can influence which questions a young person chooses to pursue.

Ojha's strongest contribution to Nepal may therefore be partly indirect: making planetary science feel less distant to a generation that first encountered Mars through his name.

## The Career Beyond One Discovery

A scientist who becomes famous early can spend the rest of a career being introduced through the same finding. Ojha has avoided becoming professionally trapped inside the RSL story by expanding into planetary interiors, Europa and exoplanets.

This is the more important long-term trajectory. Scientific careers become durable when curiosity keeps moving beyond the question that first attracted attention.

That willingness to revise is what separates science from myth. The value of a discovery is not that it freezes one interpretation forever, but that it opens a line of investigation robust enough to survive disagreement.

**Lujendra Ojha's journey from Nepal to planetary science began because he looked carefully at Mars and noticed something other people had missed. The deeper lesson is not that he "found water." It is that discovery begins when someone is willing to treat a small anomaly as a serious question—and disciplined enough to let new evidence change the answer.**

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