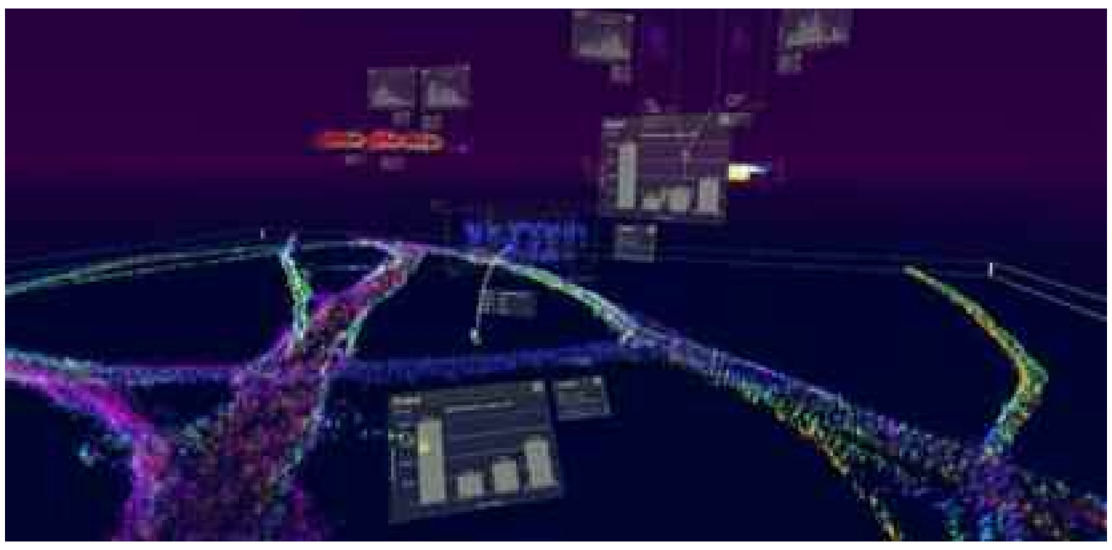
Walking inside individual cells

It could be used to understand fundamental problems in biology.

Scientists at the University of Cambridge and 3D image analysis software company Lume VR Ltd. have developed a virtual reality software called vLUME that allows us to 'walk' inside and analyze individual cells. In addition, the software allows super-resolution microscopy data to be visualized and analyzed in virtual reality and can be used to study everything from individual proteins to entire cells.

Dr. Steven F. Lee from Cambridge's Department of Chemistry said, "Biology occurs in 3D, but up until now it has been difficult to interact with the data on a 2D computer screen in an intuitive and immersive way. It wasn't until we started seeing our data in virtual reality that everything clicked into place."

Alexandre Kitching, CEO of Lume, said, "vLUME is revolutionary imaging software that brings humans into the nanoscale. It allows scientists to visualize, question, and interact with 3D biological data, in real-time, all within a virtual reality environment, to find answers to biological questions faster. It's a new tool for discoveries." By allowing us to see our virtual reality data, the software could be the game-changer in biology. It can stimulate new initiatives and ideas. For testing, Anoushka Handa – a Ph.D. student from Lee's group, used vLUME to imager her immune cell taken from her blood. What she experienced was fascinating. She stood inside her cell in virtual reality.



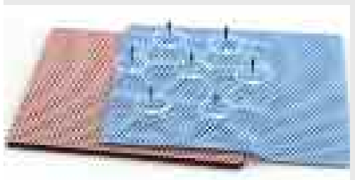
She said, "It's incredible – it gives you an entirely different perspective on your work."

Kitching said, "The software allows multiple datasets with millions of data points to be loaded in and finds patterns in the complex data using in-built clustering algorithms. These findings can then be shared with collaborators worldwide using the image and video features in the software."

"Data generated from super-resolution microscopy is extremely complex. For scientists, running an analysis of this data can be very time-consuming. With LUME, we have managed to vastly reduce that wait time allowing for more rapid testing and analysis." Lee said, "Through segmenting and viewing the data in vLUME, we've quickly been able to rule out certain hypotheses and propose new ones.

This software allows researchers to explore, analyze, segment, and share their data in new ways. All you need is a VR headset."

A rare form of magnetism can arise in Graphene



Recently, scientists from Columbia University and the University of Washington have discovered that Stacking and twisting a three-layer graphene structure could unlock a variety of exotic electronic states, including a rare form of magnetism. The work was inspired by recent studies of twisted monolayers or twisted bilayers of graphene, comprising either two or four total sheets. These materials were found to host an array of unusual electronic states driven by strong interactions between electrons. Cory Dean, a physics professor at Columbia University, said, "We wondered what would happen if we combined graphene monolayers and bilayers into a twisted three-layer system. We found that varying the number of graphene layers endows these composite materials with some exciting new properties that had not been seen before."

For the study, scientists stacked a monolayer sheet of graphene onto a bilayer sheet and twisted them by about 1 degree. At temperatures a few degrees over absolute zero, the group array of insulating states—which don't lead power-driven by solid associations between electrons. They additionally found that these states could be controlled by applying an electric field over the graphene sheets. Assistant Professor Matthew Yankowitz said, "We learned that the direction of an applied electric field matters a lot." Pointing the electric field toward the monolayer graphene sheet resulted in twisted bilayer graphene. When scientists flipped the electric field's direction and pointed it toward the bilayer graphene sheet, it mimicked twisted double bilayer graphene—the four-layer structure. The team also discovered new magnetic states in the system. In addition to the magnetism, the study uncovered signs of topology in the structure. Akin to tying different types of knots in a rope, the material's topological properties may lead to new forms of information storage, which "may be a platform for quantum computation or new types of energy-efficient data storage applications. **—Agencies**

The rain really can move mountains, study

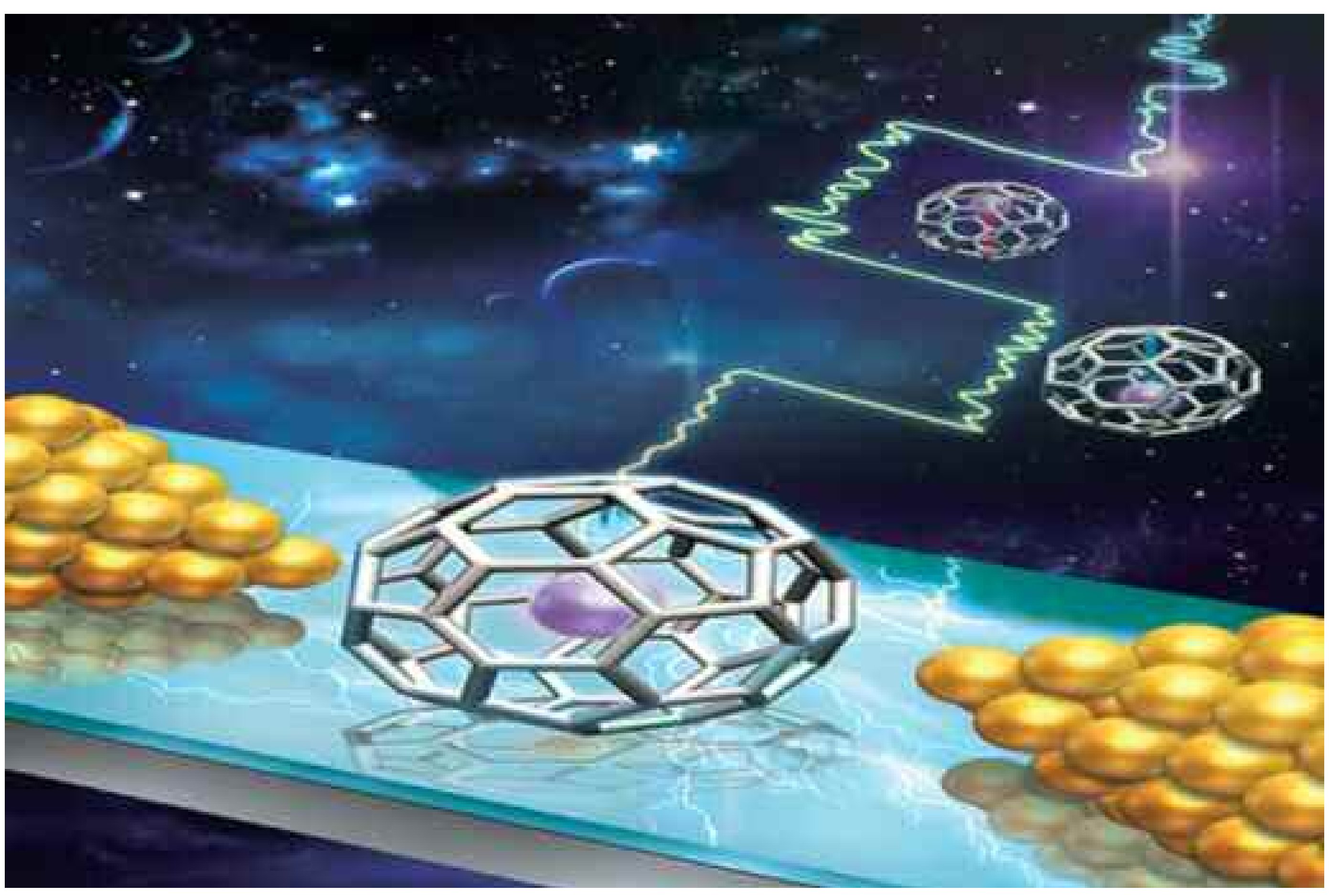
The capacity of climate to influence tectonics has been of growing interest for over a century. Likewise, the dramatic effect of rainfall on the evolution of mountainous landscapes is widely debated among geologists.

In a new study, scientists from the University of Bristol calculated the impact of rainfall, giving detailed insights on how peaks and valleys have developed over millions of years. The study, which focused on the mightiest mountain ranges- Himalaya– could forecast the possible impact of climate change on landscapes and, in turn, human life. Their study also proves rain really can move mountains. Lead author Dr. Byron Adams, Royal Society Dorothy Hodgkin Fellow at the university's Cabot Institute for the Environment, said: "It may seem intuitive that more rain can shape mountains by making rivers cut down into rocks faster. But scientists have also believed rain can erode a landscape quickly enough to essentially 'suck' the rocks out of the Earth, effectively pulling mountains up very quickly. Both these theories have been debated for decades because the measurements required to prove them are so painstakingly complicated. That's what makes this discovery such an exciting breakthrough, as it strongly supports the notion that atmospheric and reliable earth processes are intimately connected."

The study was based in the central and eastern Himalaya of Bhutan and Nepal. Using cosmic clocks within sand grains, scientists measured the speed at which rivers erode the rocks beneath them. Dr. Adams said, "When a cosmic particle from outer space reaches Earth, it is likely to hit sand grains on hillslopes as they are transported toward rivers. When this happens, some atoms within each grain of sand can transform into a rare element. By counting how many atoms of this element are present in a bag of sand, we can calculate how long the sand has been there, and therefore how quickly the landscape has been eroding." "Once we have erosion rates from all over the mountain range, we can compare them with variations in river steepness and rainfall. However, such a comparison is hugely problematic because each data point is challenging to produce, and the statistical interpretation of all the data together is complicated." Scientists overcame this challenge by combining regression techniques with numerical models of how rivers erode.

They tested several numerical models to reproduce the observed erosion rate pattern across Bhutan and Nepal. Fascinatingly, one of the models accurately predicts the measured erosion rates. The model also allowed them to quantify how rainfall affects erosion rates in rugged terrain. Research collaborator Professor Kelin Whipple, Professor of Geology at ASU, said: "Our findings show how critical it is to account for rainfall when assessing patterns of tectonic activity using topography, and also provide an essential step forward in addressing how much the slip rate on tectonic faults may be controlled by climate-driven erosion at the surface." The study findings also carry significant implications for land use management, infrastructure maintenance, and hazards in the Himalayas. In the Himalayas, there is the ever-present risk that high erosion rates can drastically increase sedimentation behind dams, jeopardizing critical hydropower projects. The findings suggest more significant rainfall can undermine hillslopes, increasing the risk of debris flows or landslides, some of which may be large enough to dam the river creating a new hazard—lake outburst floods. **—Agencies**

A single-molecule electret could be the keys to molecular comput-



Smaller electronics are vital to developing more advanced computers and different gadgets. This has prompted a push in the field toward figuring out how to replace silicon chips with molecules, an effort that incorporates making creating single-molecule electret. This switching device could fill in as a platform for minuscule non-unstable storage devices. Since it appeared to be that such a device would be so unstable nonetheless, numerous in the field contemplated whether one would exist.

Scientists from the Yale University collaborate with scientists from Nanjing University, Renmin University, Xiamen University, and Rensselaer Polytechnic Institute, Mark Reed, have demonstrated a single-molecule electret. This device could be one of the keys to molecular computers. Usually, electrets are made of piezoelectric materials, for example, electrets that produce sound in speakers. Dipoles in electrets spontaneously line up in the same direction. Applying an electric field can reverse their trends.

It has always remained unknown how small you could make these electrets. In their study, the team embedded an atom of Gadolinium (Gd) inside a carbon buckyball, a 32-sided molecule, otherwise called a buckminsterfullerene. When the scientists put this construct (Gd@C82) in a semiconductor type structure, they observed single-electron transport and used this to comprehend its energy states. However, the real breakthrough was that they could utilize an electric field to switch its energy state, starting with one stable state then onto the next. Mark Reed, the Harold Hodgkinson Professor of Electrical Engineering & Applied Physics, said, "What's happening is that this molecule is acting as if it has two stable polarization states. We ran various experiments, measuring the transport characteristics while applying an electric field, and switching the states back and forth. We showed that we could make a memory of it – read, write, read, write." "The present device structure isn't currently practical for any application, but proves that the underlying science behind it is possible." "The important thing in this is that it shows you can create in a molecule two states that cause spontaneous polarization and two switchable states. And this can give people ideas that maybe you can shrink memory down literally to the single molecular level. Now that we understand that we can do that, we can move on to do more interesting things with it." **—Agencies**

The world's first room-temperature superconductor

For the first time, engineers and physicists from the University of Rochester have synthesized new superconducting material at room temperature. They also developed a process that may help 'break down barriers and open the door to many potential applications.' This superconducting material seems to conduct electricity without any resistance at temperatures of about 15 °C. That's a new record for superconductivity, a phenomenon usually associated with very cold temperatures.

Ranga Dias, an assistant professor of mechanical engineering and physics and astronomy, said, "Developing materials that are superconducting—without electrical resistance and expulsion of a magnetic field at room temperature—is the "holy grail" of condensed matter physics. Sought for more than a century, such materials can change the world as we know it." In establishing the new precedent, scientists combined hydrogen with carbon and sulfur to photochemically synthesize simple-organic derived carbonaceous sulfur hydride in a diamond anvil cell, an examination gadget used to inspect minuscule measures of materials under extraordinarily high pressure.

The carbonaceous sulfur hydride exhibited superconductivity at around 58 degrees Fahrenheit and a weight of around 39 million pounds for each square inch (psi). Dias said, "Because of the limits of low temperature, materials with such extraordinary properties have not quite transformed the world in the way that many might have imagined. However, our discovery will break down these barriers and open the door to many potential applications."

According to scientists, the applications for this new superconducting material includes:

Power grids transmit electricity without the loss of up to 200 million megawatt-hours (MWh) of the energy that now occurs due to resistance in the wires.

- A new way to propel levitated trains and other forms of transportation.
- Medical imaging and scanning techniques, such as MRI and magnetocardiography.
- Faster, more efficient electronics for digital logic and memory device technology.

Dias says, "The next challenge is finding ways to create the room-temperature superconducting materials at lower pressures, so they will be economical to produce in greater volume. In comparison to the millions of pounds of pressure created in diamond anvil cells, the atmospheric pressure of Earth at sea level is about 15 psi." **—Agencies**