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JUng

Green Science, Green Life

Urban Roof-Farming: Where Concrete Meets Plants

Blogging for the Green Science: Interview with Samantha Jakuboski

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Preface

Editorial Note

Dear Reader,

Following the current trend of making sure that all goods are organic, fair trade and biodegradable our second issue this year is all green.

Blogger Samantha Jakuboski is dedicated to spread the word about climate change since an early age. Read what she has to say in her interview. We can still learn a lot!

For those who don't have a garden or at least a small balcony to grow crops on, there is hope: urban gardening. See what can be done in your streets in our short essay about Cueillette Urbaine.

Unfortunately, another interview with Tim Janßen about "Cradle to Cradle" cannot be published yet. We must wait until our next issue in January 2018. Be excited to learn how we can preserve our nature by using renewable energy and recycling food and waste. And last but not least:

Congratulations to Esther Vogel, the winner of our photo contest in August!

Since there were no submissions for articles, unfortunately this section must be left empty. Again, here comes the call to our readers: please help to raise the attention on JUnQ. Tell your friends and colleagues about the Journal of Unsolved Questions. There is no shame in null or negative results. Share your experiences with the world and help your colleagues to learn.

With this in mind keep digging through the JUnQ to find the hidden treasures in green sciences and green lives!

— Tatjana Daenzer

JUnQ Photo Contest: Take Your Camera and Shoot

During the last months we have received a lot of funny pictures from our readers. Unbelievable how much inspiration you can find in labs and offices! Luckily, we did not have to choose since the winning picture was drawn by lot.

And here it is:



Figure 1: *Magnified Vascular Bundle* ©*Esther Vogel.* "Be happy if your laboratory experiment works! Bright smile :D"

— Esther Vogel

The winner is Esther Vogel with her photo of a magnified vascular bundle. If you look at it even more closely you might recognize a big-eyed, bearded smiley. Lucky are those, whose experiments smile back.

Esther is not only rewarded with the publication of her photo but also with an amazon coupon. Congratulations!

We thank all the participants and wish them good luck for the future.

A Comment on Arts and Sciences from an Industrial Point of View

Even though I left the JUnQ Editorial Board over a year ago and am very busy in my job in industry, the desire for experiment never left me. The reason for experimenting in in my current job differs from academia – you need to earn money and usually do not publish your results. But one thing always remains the same: You get your fair share of failure!



Figure 1: Test of new colored ink in fountain and rollerball pens...leaking ©Andreas Neidlinger.

When I heard about the photo contest JUnQ organized, I thought to myself: Why not submit a picture of my current experiments to provide proof that you will always have the same fun, even when your studies are over? What you see is no fancy laboratory equipment and no grandiose new discovery elegantly captured for the posterity. It is just some quality check and product development for the writing instruments industry. The outcome might not fulfil the customer's needs and at first it caused a big laugh. Later, it meant more work. Just like in academia. Some things never change ...

- Andreas Neidlinger

Interviews and Essays

Of Blogging and Climate Change

Samantha Jakuboski¹ graduated as Bachelor of Science at Columbia University (Barnard College) in cellular and molecular biology. She dedicated much time during her studies promoting eco-friendly acting and explaining major climate issues on blogs like Nature Journal Scitable [1] and EcoPlum [2].

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JUnQ: You started to write for Green Science Nature blog six years ago, in ninth-grade. This is pretty uncommon to have such a sensibility about climate and green science at that age. Why did you start writing?

Samantha: I believe that climate change is a major global threat and that action must be taken to mitigate its effects. But, in order to act, we must first educate. This is why I decided to start writing. I wanted to create a source where people my own age, the next generation of leaders, could go to learn about climate change. So, I wrote a blog proposal to Nature Journal detailing my plans, and they accepted it! As a ninth-grader, I was by no means an expert on climate change. In fact, I was learning about climate change through my research for the blog posts. In a way, I believe that this naivety worked to my advantage. Since I was learning as I was going along, I first had to explain concepts to myself before explaining them to my readers. As a result, I had a sense of what worked and didn't work when explaining a concept to someone who is not very familiar on the topic. By writing at a level that was easy to understand, I hoped that students my age, as well as people of all background and ages, would be able to read my posts with ease, learn about climate change, and hopefully take steps to lead greener lives.

JUnQ: According to data cited in a blog article that you published in EcoPlum, 64% of American people believe that the earth is warming, and among then, only 52% agreed that the warning is caused by human activity. Do you have the feeling of being left alone struggling to convince people or that the word does not start being spread out?

Samantha: Since this 2014 poll was taken, the numbers have shifted upward only slightly. According to the May 2017 "Climate Change in the American Mind" survey conducted by the Yale Program on Climate Change Communication, 70% of Americans believe in climate change, with

58% of Americans believing that is it caused by human activity.

As someone who writes about climate change in the hope of raising awareness, I do find the 58% statistic to be low and a bit discouraging. However, I think it is also important to realize that we are making progress; 58% is the highest percentage recorded since the Yale survey was started in 2008.

JUnQ: Position of President Trump on climate change is to deny it. Immediately, governors, mayors, etc. rose up against it, and promise to fulfill engagement that the climate would benefit. Do you think that these engagements would compensate, at least, or overbalance the bad things Trump's politic about climate could/will engender?

Samantha: While President Trump has accepted that climate change is indeed happening, he still, unfortunately, does not believe it is rooted in man-made activity. As a result of his weak stance, I definitely think that climate change believers on both the individual and corporate level are now more vocal, as evidenced by the We are Still In [3] Paris climate agreement coalition, and the People's Climate March on Trump's 100th day in office.

While our president may refuse to accept the anthropogenic roots of climate change, I think that if states, local governments, and businesses, establish and work toward individual green goals, our nation can continue to make strides toward the 26-28% reduction in national greenhouse gases by 2025 that we pledged in the Paris Peace Accords.

JUnQ: Does being aware mean acting toward climate change for everyday life of an American people (e.g. garbage sorting, water and/or energy saving, ecological cars, eat less to eat better)?

Samantha: Absolutely. If one is truly aware and educated, I don't see how they can not incorporate little acts of "greenness" into their daily lives.

JUnQ: How to live green as U.S. citizen, what has been done and what remains to be done at personal point of view?

Samantha: In my household, we recycle, use LED lightbulbs and energy efficient appliances, compost, and try to reduce the amount of disposable paper and plastic items we purchase. We also unplug appliances, such as phone chargers and TVs, when we are not using them, since they can contribute to "vampire energy"- energy that is consumed even when the devices are not in use. Further, I love to run, and my father enjoys riding his bike, so rather than hopping in our car and driving, we take a more active approach when we need to get places (I guess it helps that we also live in New York City, where everything is so close!) While these little life-style changes are small, they do allow us to reduce our individual and household carbon footprints. When people ask me what they can do to live greener lives, I name these examples and tell them that small actions do add up and make a difference. However, there is still a lot of work that needs to be done in motivating people to make these easy daily changes. Some people I know still don't recycle!

JUnQ: And at a larger scale (cities, companies, state)?

Samantha: It is now up to businesses and local governments to lead the charge against climate change. And already, over 1,200 governors, mayors, colleges, businesses, and investors have signed the We Are Still In [3] agreement to ensure that the United States continues to reduce its carbon emissions.

Further, I think that our colleges and universities must prepare our students, especially business school students, to deal with the consequences of climate change so that our

References

- [1] https://www.nature.com/scitable/blog/green-science
- [2] https://shop.ecoplum.com/blogs/sustainable-living/
- [3] http://wearestillin.com/

future leaders can realize their corporate social responsibility and make smart eco-friendly business decisions.

JUnQ: Among all the consequences of climate change, which one is the most unexpected and worrying?

Samantha: While few people may link climate change to conflict and terrorism, it appears that there may be some direct correlations. One of my friends at Barnard College recently wrote a dissertation on climate change as a precursor to conflict– specifically on how anthropogenic climate change and drought induced the Syrian Civil War. As resources, such as water, become scarcer, and agriculture becomes depressed due to drought and rising temperatures, the prospect of future conflict does worry me.

Another unexpected consequence of climate change is the economic impact. When people think of climate change, they think of numbers such as the rise in temperatures or ocean levels. However, climate change will also affect the finances of future generations. In September, I wrote a post for EcoPlum called "Pay Up, Millenials." In this post, I explained that people are less productive at extreme temperatures, thus causing a decrease in national GDP. Furthermore, as extreme weather caused by climate change continues to wreck havoc and cause billions of dollars in damage, taxpayers can expect to face higher taxes to pay for these costs. As a result of both lower GDP and increased taxes, a Demos and NexGen Climate analysis found that if no action is taken to combat climate change, a 21-year-old 2015 college graduate earning a median income can expect their lifetime income and wealth to decrease by \$126,000 and \$187,000, respectively. The predicted loss in wealth jumps to \$764,000 for a college graduate born in 2015 earning a median income. Ouch.

JUnQ: Thank you very much for this interview!

- Adrien Thurotte

Urban Farming

Cueillette Urbaine¹, meaning « Urban gathering » in French, is a society commited to turn green the cities, by producing local organic food on the available buildings roofs. Cueillette Urbaine also aims to associate local urban production and restoration in the same space, where customers could gather and choose their own fruits and vegetables to be cooked afterwards. Thus, it removes the environment costs of the transport, but it also enables to recycle organic food waste, to improve the biodiversity in the cities, to manage rainwaters, etc...

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Cueillette Urbaine belongs to the new wave of urban farming. Nonetheless, growing out of the soil and creating new ecosystems in the core of the cities is a real urban challenge. Therefore, scientific research work is needed to develop new cultivation technologies, to assure a high quality production. Indeed, bringing soils from elsewhere is not a sustainable solution, as transport environmental costs could be higher than carrying food from the rural areas to the cities. Therefore, developing hydroponics, aquaponics or like Cueillette Urbaine new cultivate substrates is essential for sustainable food production in the cities. For instance, Cueillette Urbaine is leading a research and development project to evaluate the effects of different types of substrates (coffee ground, lawn cuts, compost...) on the plant growth. Secondly we focus our research on vegetal association benefice in particular to avoid diseases, ameliorate the pollination and finally to create an equilibrate ecosystem. Finally, we work on wicking systems to avoid hydric stress.



Figure 1: Growth pots ©Cueillette Urbaine.

Besides, during the past 10 years, policy and science have worked in pairs in order to develop urban agriculture. There is a current need to define a proper institutional frame for urban agriculture, and this requires the collaborative research work of different types of scientists: geographers, economists, agronomists, urbanists, sociologists, etc. Cueillette Urbaine chooses to foster urban agriculture development by doing action-oriented research, which means combining research and practical work. Transforming practice into knowledge is also a way to close the gap between policies and urban farming by providing the policy makers information based on evidence. Thanks to these encouraging results and all the proved benefits of urban farming, city administrations pay increasing attention to urban agriculture development. For instance, Paris city aims at enhancing its urban food production area to 120 ha by 2020!



Figure 2: Harvested vegetables ©Cueillette Urbaine.

During many years urban agriculture has emerged as a fashion effect. Today, the massive use of chemical fertilizers and pesticides has made a lot of land infertile, in addition to that the expansion of cities causing the disappearance of arable land. We believe that a production of fruit and vegetables in the city will not replace the conventional agriculture but it is a necessity to supply local and fresh products to the city dwellers without any transport.

— By courtesy of Urban gathering compagny. Edited by Adrien Thurotte.

Views on Life, the Universe, and Everything

Questions of the Week

The Journal of Unsolved Questions presents a "Question of the Week" on its homepage every week. Set up and formulated by the members of the editorial board, or guest writers, the main purpose of the "Question of the Week" consists in intriguing the reader by presenting topics of ongoing research. "Questions of the Week" published so far cover a wide variety of scientific fields, but share the feature to be of certain interest to several disciplines. In the following, we present selected "Questions of the Week" from the last six months.

From the cloud into the fog How will the IT technology develop within the next decade? Kai Litzius

Firstly, the term itself refers to the nowadays common praxis to "outsource IT activities to one or more third parties that have rich pools of resources to meet organization needs easily and efficiently" [1, 2]. In other words, one buys the permission to use hardware, network connectivity, storage, and software that is located in a computing center anywhere in the world. It is more or less comparable to other known public utilities such as electricity, water and natural gas [1] and follows the same rule: You pay for what you need, not more.

The private sector is also more and more part of the system. Cloud memory saves personal data and makes it available from any place with an internet connection, file sharing websites are widely used and gained a lot of popularity within the last years. Another kind of cloud computing is especially interesting for research: Branches with high computational needs, e.g. astrophysics, medicine, and large scale facilities like CERN, can save a lot of resources by outsourcing computational power to volunteers. While their PCs are idle, a program starts in the background and performs calculations for the project [3].

The current state of cloud computing is already very impressive, however there is one major goal the IT industry starts to tackle now, namely the so-called Internet of Things (IoT). An example is Near Field Communication (NFC), a set of hardware and software protocols to enable two devices to communicate wireless with each other [4]. It is already part of most modern smartphones and also widely used for contactless payment cards. More and more devices in our daily life will be included in this IoT, resulting in increased connectivity and data flow around us. The idea is to take the cloud and place it everywhere around us, basically creating a fog [5]. This now indeed called "fog-computing" could span a wide range of applications in daily life. From smart houses that adjust the temperature, to refrigerators that tell their user when they are getting empty. An even more spectacular application could be connected to the trend towards self-driving cars. Large IT companies al-

ready started to develop cars which do not need a driver any more [6]. What sounds like science fiction could become commonly available within the next decades and opens the path to some great applications of fog-computing. How about a traffic light, which already counts the arriving cars and adjusts its phases according to the traffic volume or tries to prevent accidents by detecting obstacles and pedestrians much faster than any human would be able to? The possibilities are incredible.

However, one also needs to consider possible disadvantages like data safety and the problem of the totally transparent citizen. Moreover, judiciary will require a lot of adjustments and new laws, especially when the computer hardware that processes cloud data is located in another country with different data protection laws. There are a lot of changes to be made, however so far technological progress was never stoppable. We will most likely be able to observe within the next 10 years some of the biggest changes in IT technology and connectivity since the invention of the internet itself.

Read more:

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- [2] M. Armbrust, A. Fox, R. Griffith, A. D. Joseph, R. Katz, A. Konwinski, G. Lee, D. Patterson, A. Rabkin, I. Stoica, M. Zaharia, "Above the Clouds: A Berkeley View of Cloud Computing". University of California, Berkeley, Feb 2009.
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What Is The Biggest Continent On Earth?

Dania Rose-Sperling

If we think about an earth map, gigantic Asia, Antarctic and North America with Greenland comes up in our mind. However, have you ever thought more about our selfcreated 2D maps of the earth? Do those maps represent the real sizes of our countries? Are Antarctica and Greenland as big as they seem and Africa in comparison to other continents so small. The answer for most of the 2D maps we are looking at is No! The most maps do not show the true sizes of the countries, because the countries of our round planet were just planed to a 2D paper without the correct scales. Meaning the continents or countries closer to the poles look a lot bigger as they are whereas the ones close to the equator look a lot smaller (see Fig. 1).

How did this happen? Our maps are older as we think. A Belgian geographer and cartographer Gerhard Mercator from 1569 designed those maps we are still looking at. This model is convenient for the seafaring, because you need equatorial azimuthal projections for navigation. In terms of ratios of the countries, the model is indeed sometimes wrong. It does show Greenland and Antarctica totally stretched and therefore bigger as they are. For example, Africa is 14 times larger than Greenland in reality. Madagascar is actually bigger as the United kingdom. Where Ireland also is 3 times smaller than it seems to be on a map of Mercator (see Fig. 2).



Figure 1. Scaling effect of global maps. The circles would all have the same size on the Earth's surface. [1] Copyright: BY-SA 2.5 (Eric Gaba).



Figure 2. Direct comparison of different regions.

There are several approaches now on shedding some light on this fact. One webpage showing the optical illusions is called "true size" [4]. Here you can move countries to another region of the earth and their scale will be dynamically adjusted dependent on the local distortion of the map. Another example is given here with a map built using the Cahill–Keyes projection (first proposed by Cahill and refined by Keyes in 1975). In this ensemble, the map provides an easy understanding of the continents with a minimized distortion (Fig. 3). Of course, another possibility to have a quite precise image of our world is to have a globe if you have enough room to have it.



Figure 3. Political world map for 2013 CE using the Cahill-Keyes Projection. Copyright: Duncan Webb CC BY 1.0.

Read more:

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- [5] https://www.youtube.com/watch?v=KUF_Ckv8HbE

How normal glass can be (nearly) indestructible – The secret of the Prince Rupert's Drop Kai Litzius

Ordinary glass as it is used for windows can exhibit exceptional behaviors and even shred a rifle bullet to pieces, furthermore it can help to make car windows safer and to understand the inner processes in volcanos.

Key to all these fascinating properties are the so-called Prince Rupert's Drops. These structures are solidified drops

of glass, which are produced by letting a drop of molten glass fall into a bucket of water. The sudden shock caused by the massive temperature drop on the surface of the glass basically locks in the outer shape of the drop, preserving main body and tail (Fig. 1). [1,2,3]

This object has now very unique properties: If the main

body of the droplet is hit by a hammer, it practically never breaks. It even withstands a direct hit of a rifle bullet, whereas the bullet can be completely shred to pieces. All this the main body of the glass droplet can stand without breaking. However, if there is too much force applied to the fragile tail of the Prince Rupert's Drop, or if it is even just nicked, the whole drop explodes into tiny pieces of glass that can spread over several meters. [4,5]



Figure 1. Prince Rupert's Drops. The thick main body with the long, thin tail is well visible (Copyright: public domain). [1]

To understand how this fascinating behavior is created, we have to have a closer look at how the drop is created. Everything starts with a drop of hot, molten glass, suddenly getting in contact with water. As mentioned, the outer layer of the drop immediately solidifies and locks in the characteristic drop or tear shape. The thin tail is created when the drop detaches from its origin (e.g. the glass rod) and starts falling and also gets locked into its shape when touching the water for the first time. While the outer layers are now already solid glass, the interior of the drop is still a hot liquid (Fig. 2 top).



Figure 2. Mechanism of creation of a Prince Rupert's Drop. The hot, liquid interior of the drop compresses against the already hardened outer shell. The result is a highly strained structure (Copyright: CC-BY JUnQ). [4,5]

Consequently, this glass contracts while cooling down and starts pulling the solid outer layers inward, stressing them just like an arch bridge is stressed (compressive strain) and thereby stabilizes the structure. Along the axis of the drop, however, the strain is not compressive but tensile, because the shrinking material tries to pull along the tail.

These stresses make the round shaped main body of the drop extremely resistant to external disruptions, whereas the tail constitutes a weak spot (Fig. 2 bottom). If the latter is now damaged in any way, the energy stored in the mechanical stress can be released and a mechanical failure front runs through the material, destroying more and more of it until the main body is shredded into dust. This process can happen with a speed of around 1600m/s, just like an explosion, and it usually only ends with the pulverization of the whole drop. Thus, this is the secret of the Prince Rupert's Drop; it is always experiencing extreme internal stress that makes the convex part so extremely stable (like an arch bridge) that even rifle bullets shatter on them.

Finally, in its cooled state, the drop represents a system that exhibits extreme internal stresses. These stresses make the round shaped main body of the drop extremely resistant to external disruptions, whereas the tail constitutes a weak spot (Fig. 2 bottom). If the latter is now damaged in any way, the energy stored in the mechanical stress can be released and a mechanical failure front runs through the material, destroying more and more of it until the main body is shred to dust. This process can happen with a speed of around 1600m/s, just like an explosion, and it usually only ends with the pulverization of the whole drop. Thus, this is the secret of the Prince Rupert's Drop; it is always experiencing extreme internal stress that makes the convex part so extremely stable (like an arch bridge) that even rifle bullets shatter on them.

So, we can ask whether this effect can be useful for anything. The answer is yes, indeed. Exactly the same principle is used in tempered glass like it is used e.g. in car windows. This glass does not shatter into sharp shards, but instead produces relatively smooth and small pieces and therefore is less harmful for the passengers of the car in case of an accident. Currently, Prince Robert's Drops are even researched to understand better the quick cooling of volcanic lava under certain circumstances and therefore the inner processes within a volcano. Thus, all in all, these fascinating objects are full of wonders.

Read more:

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- [3] http://www.experimentis.de/physikalisches_spielzeug/ mechanisch-kinetisch/teufelstraenen-bologneser-traene/
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Why do raw and cooked eggs rotate differently?

Adrien Thurotte

Put a raw egg on a flat table, and give it a good spin with two fingers. The egg spins, however, rather slowly because the liquid inside poorly exchanges momentum with the outside shell. Thus, when you spin the egg by applying force to the shell, most of the inside resists the motion and the friction forces between the inside (immobile) and the shell (mobile) will be slowing down the egg's speed. But if you consider a cooked egg, proteins contained inside the egg are now forming a solid phase that is tightly joint to the shell. In that case, there are no friction forces in the "egg system" and the movement is not slowed down.



Figure 1. An egg spinning upright.

In this case now, the only existing friction forces are those

between egg and the support (the table) and the air (which

can be reasonably neglected). If your initial momentum transfer is strong enough, you observe a strange phenomenon: the spinning egg starts to rotate upright.

The physical concept used to explain this phenomenon is inertia. Spinning ice skaters can reduce their moment of inertia by pulling in their arms, allowing them to spin faster. You can also sit on a swivel chair and spin on yourself. Extend your arms horizontally and you will slow down. The same is happening with the egg. Friction forces tend to slow down the egg, and decrease overall energy. To save energy, like the skater, the egg stands up and the momentum of inertia consequently decreases.

To spin upright, the egg needs some energy, exactly as one needs some energy to get up in the morning, fighting against gravity. The necessary energy is provided by the rotation itself, and the change of orientation of the egg will only happen if the spinning is fast enough.

Read more:

 Bou-Rabee, N. M., J. E. Marsden, and L. N. Romero, A geometric treatment of Jellett's egg, Angew. Math. Mech. (ZAMM) 85, (2005), 618-642

Do Ball Lightnings Exist?

Tatjana Daenzer

Sometimes they come and go with a bang, sometimes they are silent. They glow bright as a lightning in white, yellow, red or blue. They fly freely through the room and some of them even permeate solid matter. They all have in common that they appear mostly during stormy weather, are somewhat spherically shaped and have a lifetime of several seconds. [1] For many centuries people report about observations of lightning balls as depicted in figure 1. effect is not as dramatic. A full scientific explanation is not yet found. Do they really exist or are they only the product of frightened people's minds?

Sure, bolts can cause phosphenes, impressions in the focus of the eye that remain some moments after looking into bright lights. [3] But during the last years scientist came up with some experiments that deliver plausible explanations of their formation:



Figure 1. Illustration of a ball lightning from the early 20th century. [2]

Clearly, ball lightnings cannot be the same phenomenon as a strong electric discharge like a bolt lightning since their



Figure 2. Result of the water discharge experiment from 2014. [6]

Abrahamson and J. Dinniss found out that after the impact of a bolt into the soil a cloud of Silicon (Si), Silicon carbide (SiC) and Silicon monoxide (SiO) nanoparticles evaporates and oxidizes in a timespan of several seconds. During this

time the energy is released as a bright ball-shaped light. [4] At the IPP in Garching, Germany, Prof. Dr. Gerd Fu?mann vaporized and ionized a tiny amount of water by an electrical discharge between two electrodes above a water surface. The glowing plasma cloud, called plasmoid, has a spherical or mushroom-like shape (shown in Fig. 2) and a lifetime below one second. [5] The appearance of these plasmoids is demonstrated in a short video on their web page: http://www.ipp.mpg.de/2977926/kugelblitze

Still these experiments lack to explain all the observed properties of a ball lightning: the free movement, the ability to permeate matter and the long lifetime of several seconds. It is plausible that there might occur spherical light phenomena during bolt impacts. An explanation of the rather vivid properties of a ball lightning is yet to come. But maybe they belong to the section of narrative decor.

Read more:

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