菩提田
Bodhi Field

水、大地、太空
Water, Earth and Outer Space

張煒 整理/翻譯
Compiled and Translated by Wei Zhang

萬佛聖城周日晚佛法講座系列之一，邀請到理論粒子物理學與宇宙學家、現任教於臺灣大學物理學系並擔任梁次震宇宙學講座教授陳丕燊博士；台灣中央大學地球科學學院院長趙丰博士；美國地質研究所地震科學中心前主任湯姆・波若徹博士與聽眾分享他們在各自領域的研究概論，提高聽眾對科學的理解以及關注，也反思人類與大自然之間的和諧共處。

As part of the Sunday Evening Lecture Series, the City of Ten Thousand Buddhas hosted three distinguished speakers: Dr. Pisin Chen, a theoretical particle physicist and cosmologist who teaches at the Department of Physics of the University of Taiwan, C.C. Leung University Chair Professor of Cosmology. Dr. Ben Chao, former Dean of the School of Earth Sciences at the National Central University of Taiwan; and Dr. Tom Brocher, former Director for the Earthquake Science Center of the U.S. Geological Survey. They gave a brief overview of their respective research areas, aiming to increase the audience's interest and awareness of science, and to explore the harmony between human beings and the natural world.

「穿越時空談宇宙」
陳丕燊博士
2021年12月12日
梁次震宇宙學與粒子天文物理學研究中心主任

"Our Amazing Universe"
Dr. Pisin Chen
December 12, 2021
Director of Leung Center for Cosmology and Particle Astrophysics

陳丕燊教授對於物理宇宙學的認知做了一個簡要而又涵蓋方方面面的介紹。宇宙的概念，本身同時囊括了大到哈勃尺度，也就是宏觀宇宙例如遙遠的恆星的尺度，以及小到普朗克尺度，也就是比原子還要小的夸克等微觀世界的尺度。雖然這兩個尺度看上去差別非常大，但它們卻有一個交匯點，就在宇宙大爆炸。

Dr. Pisin Chen gave a brief but thorough overview on the physics of the universe. The concept of the universe spans from the Hubble Scale, which measures the size of the macro universe like the stars far far away from the earth, to the Planck Scale, which measures the size of the micro universe like the quarks, which are even smaller than atoms. Drastically different in today's sizes in the two scales, the two actually meet at the Big Bang.

There are 200 billion stars like the sun in the Milky

我們所在的銀河系有2000億個類似太陽的恆星，而銀河系本身又只是無數星系中的一個。星系彼此通過引力牽引，形成星系群，而星系群又進一步彼此如網狀關聯形成超星系團。雖然尺寸上如此巨大，但常規認識的物質（我們所熟悉的物質）卻只佔總質量的5%，而其他的95%被認為是所謂的暗物質和暗能量。那麼宇宙是怎麼變成這麼大的呢？著名的大爆炸理論認為一切都始於宇宙大爆炸。

在這個理論裡，宇宙誕生於一次大爆炸。大約138億年前，一個密度極高的奇點發生了巨大的爆炸，爆炸的物質在很短的時間內經歷了膨脹，從而幾乎達到了現在宇宙的這個尺寸。然後是漫長的繼續膨脹，也就是所謂哈勃膨脹。宇宙大爆炸的殘留物，已被確認為背景黑體幅射。馬克斯·普朗克首次提出了黑體幅射的正確公式「量子」，即離散的能量包。這一理論已經得到了進一步的發展，又引出了如何解釋宇宙中普遍觀測到的微小的不均衡性的問題，而解決這個不均衡性疑問的，則是量子躍遷這個概念。正是有了量子躍遷，以及無處不在的不均衡性，才有了各種各樣的星球，包括我們所在的地球。

然而根據觀測到的物質，這些理論依然不能解釋為何恆星的轉速和遙遠星系抵達銀河系的光線傳播路徑等問題上，理論計算值和觀察到的現象有很大的偏差。這最終導致了暗物質理論的提出，該理論認為在我們以為「空無一物」的宇宙空間裡，充斥著大量的無法常規觀測的暗物質。不僅如此，新的天文觀測還發現，原本認為應該在逐步減速的宇宙膨脹，現在卻是還在加速。這些理論與觀測的衝突最終帶來了暗能量的理論，但關於暗能量的細節，或者是暗能量的未來的走向（關係到宇宙是否還會繼續加速膨脹，以及宇宙在遙遠未來的命運），還都是謎。

我們無法直接觀測的的東西還有一樣，那就是黑洞。黑洞的密度極高（因此引力也極高），高到能夠扭曲周圍的空間和時間，連光都無法逃脫它的引力。這種扭曲也引導了蟲洞理論的出現：通過蟲洞，理論上我們可

Way Galaxy, and the Milky Way Galaxy is just one of the many galaxies in today's macro universe. Pulled by their mutual gravity, galaxies form clusters, and further string into super clusters like a web. Large as they are, ordinary matter (which we are all familiar with) only composes 5% of the total mass, with the remaining considered to be dark matter and dark energy. But how did the universe grow this big? The famous theory assumes everything starting from the Big Bang.

The Big Bang is when the universe "was born." About 13.8 billion years ago, a highly dense starting point singularity had a big explosion, went through a very fast inflation to almost today's universe size, and is now going through the relatively slow Hubble Expansion to keep expanding. The remnants of the Big Bang have been identified with the background black body radiation.

The correct formulation of black body radiation by Max Planck which first saw the introduction of "quanta", discrete packets of energy, has been further developed to explain the observed slight non-uniformity across the universe, through the concept of quantum fluctuations. Such fluctuations, and the slight non-uniformity across the universe, are actually what formed all kinds of stars and planets, including the earth.

Yet with the observable ordinary matter, the theoretical calculations results do not match those of observed rotational velocity of stars, and observed light travel paths from many far-away galaxies. This led to the theory of dark matter, which is assumed to be filling in the "empty space." Not only that — new discoveries that the universe's expansion, which was expected to be slowing down, is actually still accelerating. This conflict against current theories resulted in the assumption of a new type of energy, as "dark energy", but the details of the dark energy, or the actual future fate of the dark energy (which will determine the future trend of the universe's expansion rate and also the universe's fate in the far far future,) remains a puzzle.

Things that we did not directly observe also include another type of concept: black holes. Black holes cannot be directly seen because their high density (and high gravity) can distort time and space, and even light cannot escape. The distortion brings the theoretical wormholes,

以以很短的時間抵達很遙遠的地方。量子理論提出以後，又給黑洞理論帶來了新的發展，例如著名的有關黑洞蒸發的黑洞信息佯謬。黑洞信息佯謬代表了經典廣義相對論和量子理論的一個理論衝突，而最終經歷半個世紀的爭論之後，終於由量子糾纏這個理論將兩者聯繫了起來，但還有更多的未知等待我們去探索。

which allows much faster traveling to somewhere extremely far away. Yet since quantum theory was brought up, it has added new developments to the black hole theory too, for example, the information loss paradox in black hole evaporation. This paradox is an important debate to align the theory of relativity and quantum theory, and the half-century debate was brought to an end thanks to the quantum entanglement concept. Yet, more unknowns are still waiting to be uncovered.

編按：在這個講座中，陳教授向我們介紹了相對論和量子論之間的理論衝突和計算偏差引出的暗物質和黑洞的理論和發展。相對論和量子論能統一起來嗎？這些宇宙學課題已經碰觸到哲學、宗教、藝術、人文各領域的交匯點。通過這個講座，我們也來分享宣公上人在《華嚴經》華藏世界品第五中的經文淺釋。

Editor's Note: In this lecture, Prof. Chen introduces us to the theoretical conflict between relativity and quantum theory, and the theory and development of dark matter and black holes due to computational bias. The question arises of whether these two theories can be reconciled. Additionally, the advancements in cosmology have implications for various fields such as philosophy, religion, literature, and the arts. We will also share the explanation by Venerable Master Hsuan Hua on chapter five "The Flower Treasury Adorned Sea Of Worlds" of the *Avatamaska Sutra*.

—摘自宣公上人《華嚴經淺釋》華藏世界品第五

—An excerpt from Venerable Master Hsuan Hua's Commentary on Chapter Five, "The Flower Treasury Adorned Sea of Worlds"of the *Avatamsaka Sutra*

宇宙間之所以妙的原因就在這裡。它互相有這個風力的攝持，世界不毀滅就是這種風的力量。這種力量一般人看不見，但是你若開了五眼就可以看得見，看見這種互相吸攝的力量。雖然它是無形的，就像無線電似的，但可不會錯了。你打個無線電報，本來是無形的，但是不會錯的，因爲它有這種電的道路。

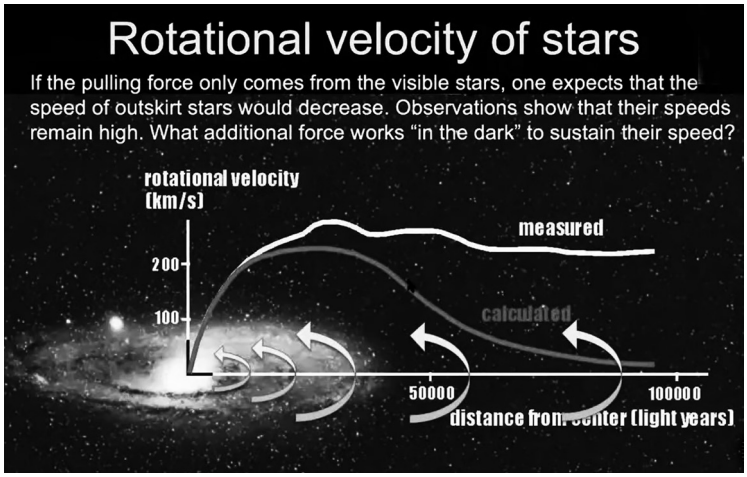
現在的人造火箭打入太空，或打上一個衛星，衛星進入軌道裡頭去，就在那兒轉多少轉也不會跌下來，這都是一種風輪的吸力在吸攝著。這種互相吸攝的力量就叫風輪。

這個世界海有種種的風輪，風輪

The universe is amazing because the celestial objects exert a gravitational force of wind that attracts and keeps them in balance. This force of wind prevents the world from collapsing. This force is invisible. You cannot see the wind unless you have developed the Five Eyes. Then you can perceive its magnetic power. It is like sending a telegram. Even though the electric current is formless, it is always accurate.

Nowadays, rockets launch satellites into orbit around the Earth. The satellites travel in their orbits and spin on their axes without falling out of their paths. The forces that keep the satellites in orbit are called wind wheels.

Even though these world systems attract each other, all the planets in these systems keep their own orbits and do not deviate or drift. You might wonder if the forces of attraction that hold the world systems, wind wheels, planets, stars, moons, and suns



之間都有一種吸力，所以能互相攝持，此世界攝持他世界，他世界攝持此世界，這都是因爲有這種風輪的力量，在虛空裡頭攝持著。虛空中雖然有很多的世界、風輪、星球、地球、月球、太陽，可是都是各行各的軌道，互不紊亂。這種互相攝持的力量，是不是風輪本身有的力量呢？不是的。那是什麼的力量？這是由於諸佛菩薩的神通力、聲聞緣覺的定力、眾生清淨和不清淨的業力互相攝持著，這個世界才能存在。這種的力量，不是一般人所能知道的。

從古以來，所有的科學家就研究這種問題，但是始終也研究不清楚。爲什麼呢？就因爲他們不懂得這個世界是由諸佛菩薩的神通力，聲聞緣覺的定力、戒力、慧力，和眾生清淨、不清淨的業力所攝持的。這種風的力量，是由種種的業力組織而成的，也是諸佛的神通力量支持的。

. . .

華嚴經所謂的世界海、香水海，都有微塵數之多。不過，我們的智慧力通達不到，所以不知道而已。其實，種種香水海、種種世界，有無量無邊之多。世界好像網一樣，不知有多少？我們沒有大智慧力到其他世界去，雖然現在登月球，這僅僅是屬於我們的世界，而不是其他世界。

我們這個世界，覺得很大，可是在諸佛眼光看來，不過是一粒微塵而已，世界與世界的位置是有一定的，不會亂七八糟，而是有條不紊。這個世界壞了，而世界網卻不會壞。因爲此世界壞，彼世界成，循環不息，周而復始。

together are in the wind itself. That is not true. Then what is the source of this power?

This power is derived from the spiritual power of the Buddhas and Bodhisattvas, the samadhi power of Pratyekabuddhas and Hearers, and the power of the pure and defiled karma of living beings. The relative attraction among these celestial bodies depends upon these powers. An ordinary person cannot begin to comprehend this kind of power, and it's not readily made known to most people.

Since ancient times, science has tried to explain these phenomena, but without conclusive results. This is because science does not grasp the spiritual power of the Buddhas and Bodhisattvas, the samadhi power of the Pratyekabuddhas and Hearers, and the combined power of their precepts and wisdom that beautifies these world systems. Nor does science understand the power of the mixed karma of living beings, whether pure or defiled. The power of the winds comes from the accumulation of the karmic power of living beings and the spiritual power of the Buddhas.

. . .

The *Avatamsaka Sutra* describes countless oceans of worlds and perfumed seas that are as numerous as dust motes in lands. Their size is beyond our understanding, but our ignorance stops us from seeing this reality. In fact, there is no limit to the number of perfumed seas and oceans of worlds. The worlds are like complex nets, their quantity infinite. We lack the wisdom to go beyond our own realm. Even though we have reached the Moon, we are still trapped in our single world and cannot explore other worlds.

To the enlightened Buddhas, our world is just a tiny speck of dust, even though it seems vast to us. They see a clear and harmonious pattern, not a chaotic existence, where every element has its proper place. The world may be broken, but the web is still intact. Even when our world collapses, a new one always rises, following the endless cycle.

「地球的水循環」
趙丰博士
2021年12月5日
台灣中央大學地球科學學院前院長

"Earth's Water Cycle"
Dr. Ben Chao
December 5, 2021
Former Dean of Earth Sciences,
National Central University, Taiwan

現在把視線拉回到我們地球本身，趙丰博士給我們帶來的演講是有關地球的水資源。地球表面目前百分之七十都是海洋，地球可以說就是一個水世界。但這還只是地球水量的一部分，因為我們一般看到的這些還都是地表水，包括我們常說的地下水，還沒有算進地球更深層的那些水，例如礦物結晶水。所以地球整體的水量是非常龐大的，而水的循環在地球整個生態裡面是極其重要的一環。但我們一般人能利用的水，卻只是地面水的很小一部分。

這麼龐大的水量，哪怕只是地表水的這部分，一旦有了什麼變化，對人類的生存的影響也是非常巨大的。最著名的就是現在常說的全球變暖。全球變暖是因為溫室氣體的排放導致的。想像一個正常的地方，太陽曬了產生了熱量，但它不會無限制升溫，因為這些熱量通常都以紅外線的形式用熱輻射耗散掉了。那麼再想像我們在這個地方罩一個玻璃蓋子，玻璃不影響太陽光曬進去加熱，但卻會阻礙紅外線向外輻射，最後的效果，就是溫室一樣，讓內部越來越熱。這就是溫室效應，也就是全球變暖的原因。而地球上的這個玻璃蓋子一樣的東西，就是加劇的二氧化碳和甲烷的濃度，因為這些所謂的溫室氣體就能產生跟玻璃這樣類似的效果。

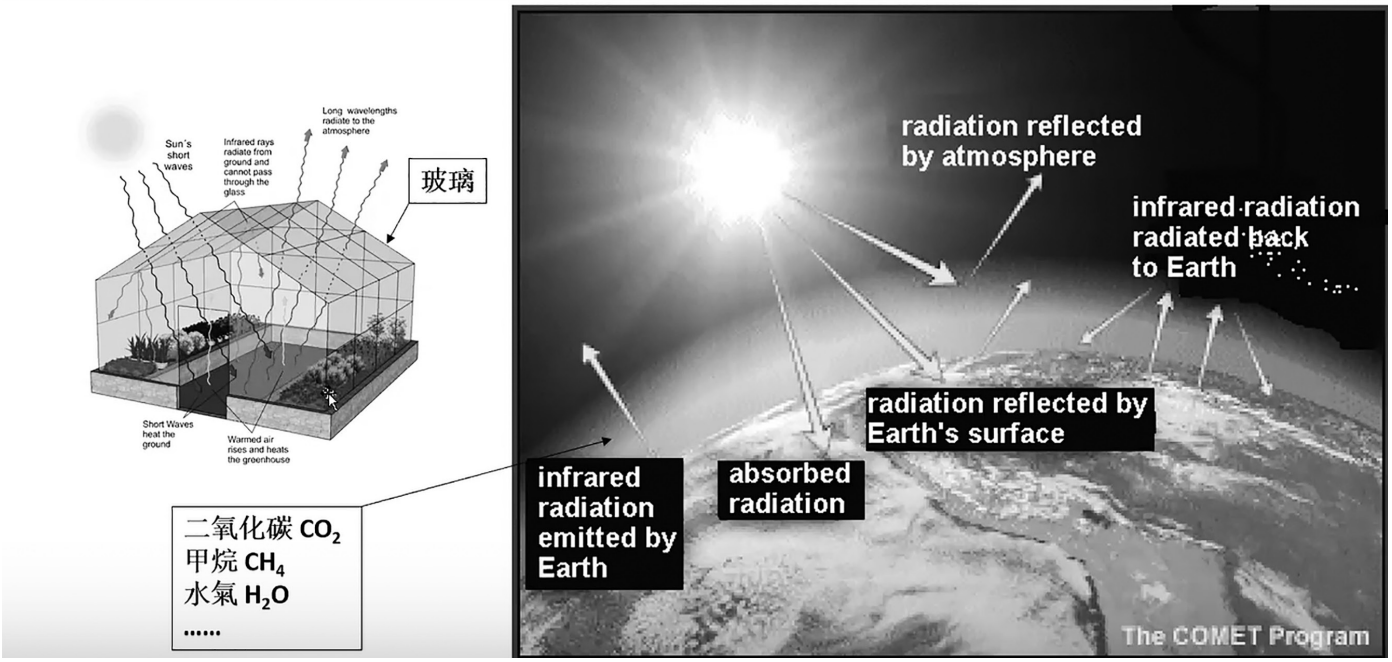
全球變暖現在已經有很多事實證據了。例如挪威的一張照片，一個小島上一百多年前有一條冰河，現在再看，已經都融化完到海裡去了。或者看西伯利亞的大片凍土，也正在加速融化，甚至裡面的猛獁象

Now let's take a step back and look into the earth itself—Dr. Zhao gave a lecture about the water resources on the earth. 70 percent of the earth's surface is ocean, so we can say the earth itself is a world of water. But this is still only a part of the earth's total water volume, because it only includes the surface water (including what we usually call as ground water), but does not include the water deep in the earth, like the water of crystallization. So the total volume of earth's water is tremendous, and the circulation of water is a crucial part in the entire ecosystem of the earth. However, the part that humans are able to make use of today is only a small fraction of the surface water.

This huge amount of water, even if we are only referring to the surface water part, will have a huge impact to human's survival if it has any significant change. One famous topic is what we call global warming. Global warming is caused by the so-called greenhouse gas. Imagine that you have one place, on which the sun is shining. It gets warm but won't keep warming up, because the extra heat is usually dissipated as infrared rays in the form of thermal radiation. Now let's imagine that we build a glass cover on top of this place. Glass won't block the sunlight or its heat, but it will block infrared rays preventing them from escaping. The final result is a greenhouse, where the inside gets really hot. This is therefore called the greenhouse effect, which is also the cause of global warming. And this "glass cover" on top of the earth is the increasing carbon dioxide and methane, because such gas has this similar effect just like the glass cover.

Global warming has been proven by many facts already. For example, a photo from Norway shows that an ice river that existed a hundred years ago is no longer seen today - it

溫室效應 Greenhouse Effect



骨骼都露出來了，而這裡的凍土融化還會釋放裡面封存的大量甲烷，從而加劇溫室效應。北冰洋地區的大片冰蓋也在融化縮小，但如果只是浮冰的話，它不會有直接的影響，因為冰化成水，它對水平面是沒有影響的。但陸地上的冰融化進入海裡，就會造成海平面的上升。例如格陵蘭島上的很多冰，如果它們全部融化，會讓海平面上升7米。南極洲的冰全部融化，預計會讓海平面上升70米。這都是很可怕的數字，一旦海平面真的上升，很多海岸都將消失，目前海拔不到一百米的地方都會被淹沒，而這是大部分人類居住的地方。現在海平面已經有上升的跡象，只是每年上升速度還比較緩慢，但時間累積一下，這個數字就開始變得可怕了，而且現在觀察到的上升幅度還在加速。

海平面和冰川的變化，其實在地球歷史上已經發生過幾次，著名的就是冰川時期，那時候海平面低，

has fully melted and merged into the ocean. The permafrost in Siberia is also melting quickly. Photos show that even the bones of ancient mammoths under there have been exposed today after the melting. The melting of the permafrost also releases a lot of methane which was sealed under the permafrost and this further increases the greenhouse effect. On the other hand, the ice in the Arctic is also melting, but if it is just the ice floating on the sea, its melting won't change anything to the sea level. But if the ice on the land melts and goes into the sea, it will raise the sea level. One example is the huge amount of ice on Greenland - if the entire island has its ice melt, the sea level will rise by 23 feet. If the entire Antarctica melts, the sea level will rise by 230 feet. These are scary numbers, because if this really happens, a lot of land will disappear; or simply put, anywhere that is no more than 300 feet above sea level today will be gone, which is unfortunately where most humans live today. Now we have already observed the rising of the sea level; it is still quite slow on a year-by-year basis. But if we look at a longer time scale, the number becomes scary, especially that the observed rising is accelerating.

The changes to sea level and ice on earth have actually occurred multiple times in the history of earth. The famous ones are the Ice Age, when the sea levels were lower and land

陸地面積比現在大。這也可以解釋為什麼我們會在現在被大洋阻隔的很多大洲會發現其他洲的人種，例如愛斯基摩人這樣的黃種人。

除了全球變暖以外，跟海平面直接相關的還有另一個更明顯的自然災害，就是海嘯。海嘯在海裡的時候其實幾乎沒有什麼大浪，可能也就一米高。但等海嘯的波浪抵達了岸邊，一波一波都往岸邊集中的時候，就產生了很高的巨浪，也就是海嘯。

最後關於地下深層的結晶水，趙博士也給了一個簡單的介紹。這裡的地下比我們通常說的地下水要深很多很多，那裡有很多礦物裡面封存了大量的水。這些水可以由地球板塊運動的假說來解釋，就是長久以來的各種板塊運動，將一些地表的水帶入了地下，越往下壓力越大，也就會形成結晶。雖然我們對這些結晶的了解非常少，但通過實驗室模擬形成的晶體來預測，這些結晶含有的水量，比所有海洋的水量加起來還要多。當然這些只是推算，目前人類也沒有辦法去開採利用。

area was larger than today. This is one way to explain why we have found traces of human races of one continent appearing on another continent that should have been separated by the oceans. One example of such is Eskimos, who are Mongoloid that are mostly found in Asia.

Besides global warming, another natural disaster that is related to the sea and is more obvious, is the tsunami. When a tsunami forms in the sea, it actually is not creating any major waves — usually at perhaps only 3 feet tall. But when the waves reach the sea coast, and stack up wave by wave, that becomes a tall one and is what we see as a tsunami.

Lastly, Dr. Zhao further introduced the water of crystallization deep inside the earth. The location is much deeper than where we think about the common groundwater, where it has a lot of crystals with water sealed in. The formation of such crystals or water can be explained by the theory of plate tectonics. The movements of plates over the long history of earth bring water from surface to under. The pressure increases as one goes deeper, and crystallization happens. Although humans know very little about these crystals, today researchers are able to simulate the formation of them in labs. By analyzing the results, researchers have predicted that the volume of total water of crystallization is even bigger than all oceans combined. Of course, this is so far just a prediction, and there is no way to make use of such water yet.

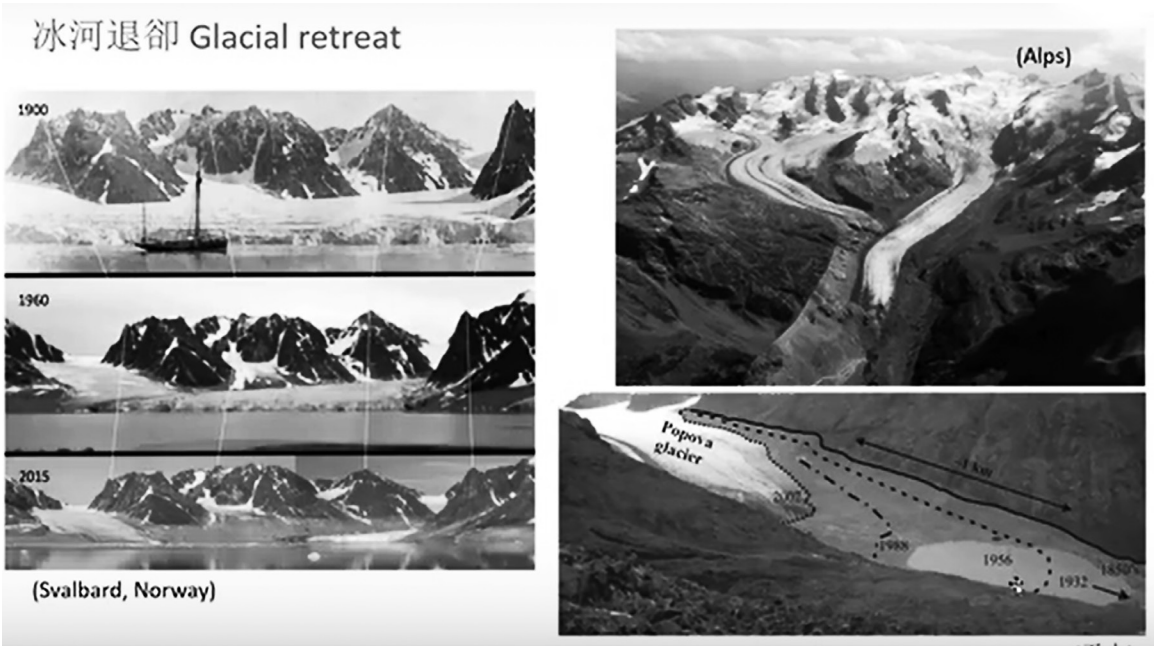
—摘自宣公上人《華嚴經淺釋》華藏世界品第五

—An excerpt from Venerable Master Hsuan Hua's Commentary on Chapter Five, "The Flower Treasury Adorned Sea of Worlds" of the *Avatamsaka Sutra*

我們這個世界有成、住、壞、空四個劫。在「成」劫裡邊又分出來成、住壞、空，在「住」劫裡邊也分出來成、住、壞、空，在「壞」劫裡邊也分出來成、住、壞、空，在「空」劫裡邊也分出來成、住、壞、空。世界的成、住、壞、空也就好像我們人的生老病死。人由一歲到二十歲可以說是「生」，由二十歲到四十歲可以說是「老」，由四十歲到六十歲可以說是「病」，由六十歲到八十歲可以說是「死」，大要的是這樣子。世界也是這樣子的，在成的時候

Worlds go through cycles of formation, stasis, decay, and extinction. Each of these phases is further divided into four sub-phases of formation, stasis, decay, and extinction. This is similar to the stages of human life: birth, old age, illness, and death. Birth covers the period from birth to age twenty. Old age ranges from age twenty to forty. Illness lasts from age forty to sixty. Death usually happens between age sixty and eighty. The same principle applies to world systems. Even in the formation phase, there are sub-phases of formation, stasis, decay, and extinction.

The climate is changing rapidly, with large swings between hot and cold temperatures. In many parts of the world, the climate is completely different from how it was in previous centuries. The



也有住、有壞、有空。

現在的氣候很不正常，有的時候就很熱，有的時候又很冷，和幾百年以前的氣候完全不同了。這些氣候的變化也就是這個世界成住壞空的變化。

你們各位研究歷史就知道，現在北歐那個地方，在第八世紀那時候有一塊土地，叫「青翠之地」（格林蘭島），就是一塊綠色的地。那時候這塊土地很肥沃的，種出來的東西長得很大。可是這個氣候一天比一天冷，一天比一天地冷，冷就結冰。等到十五世紀，把全部青翠之地的大地皮都結成冰了，現在完全變成冰原了，不能再種地，人也不能住了。那個地方在第八世紀的時候是可以住人的，到第十五世紀就不能住了，現在就更不能住了。

世界在每五百年有個小變化。每二十個五百年有個中變化，每八十個五百年有個大變化。這就是世界的成住壞空的現象。

在一萬年前，那時是大冰期。在二千五百年有個小冰期。在一萬年前，喜馬拉雅山是大海（探險家在山上發現海中的蛤蜊殼的存在）西伯利亞是熱帶，（考古學家在黑龍江沿岸發現熱帶動物的大象化石骨）。由此可證，地球時刻在變遷。

change in climate is one aspect of the cycle of formation, stasis, decay, and extinction of this world.

Let's explore the history of the world. At present, the world climate is very unstable. Sometimes it becomes very hot and sometimes it becomes very cold. In many areas of the world, the climate is entirely different from the way it was in past centuries. The transformation of the climate is one aspect of the formation, stasis, decay, and extinction of this world. If you look at history, you will find that in the eighth century, there was a large area of land in what is now northern Europe. It was called Greenland.

Greenland was very fertile and productive in the past, and it was easy to grow crops there. However, the climate gradually changed and became colder. The land eventually froze and turned into a continent of ice by the 15th century. Since then, Greenland has been frozen and barren, and no life can survive there. A large part of the continent has also vanished. People lived there from the 8th to the 15th century, but not after that.

There is a small change of the world every 500 years. There is a medium-sized change every 10,000 years. There is a great change every 40,000 years.

Ten thousand years ago, the world experienced the Last Glacial Period, also known as the Great Ice Age. Around 2,500 years ago, there was a Little Ice Age, when the climate was cooler than normal. The Himalayas used to be under the sea, (as shown by the clam shells found in the mountains.) Siberia used to be a tropical region, (as evidenced by the fossilized bones of tropical animals along the Amur River.) This proves that the Earth is constantly changing.

「地震之成因及防備之道」
湯姆・波若徹博士
2022年2月6日
美國地質研究所地震科學中心前主任

"Why Earthquakes Happen and How to Prepare for Them"
Dr. Tom Brocher
Febuary 6, 2022
Former Director for the Earthquake Science Center
of the U.S. Geological Survey

說到板塊，那就要提一下尤其加州這裡很受關注的自然災害，就是地震。湯姆・波若徹博士給我們介紹了地震的基礎知識以及如何在地震來臨時最好的保護自己。

波若徹博士首先強調的一點是，不要因為可能地震而恐慌。他舉例的一張歷史照片顯示，在一場大地震後，雖然室外的籬笆等的損傷顯示了地震的威力，但照片中的房屋卻看不出實際的損傷。事實上，在地震中，絕大多數人都是不會受傷的。

為什麼會地震呢？現代理論認為，地球中心是地核，表面是地殼，而中間則是地幔。地幔是不斷流動的，越接近地心就越熱，於是就像熱空氣會對流一樣，地幔也不停在內部對流運動，而接近地表的部分則冷卻形成地殼。根據板塊學說，這樣形成的地殼分為幾個很大的板塊，彼此之間相對也不停的在運動。雖然運動的速度很低，但運動就不時導致板塊彼此的碰撞，從而引發地震。如果我們把歷史上地震的位置都畫在世界地圖上，就可以清晰地看出板塊的邊緣。而這些運動不僅引發地震，還可能引發海嘯，所以如果我們在海邊感受到地震的話，一定要盡快（30分鐘內）離開海岸，去高處躲開之後可能襲來的海嘯。

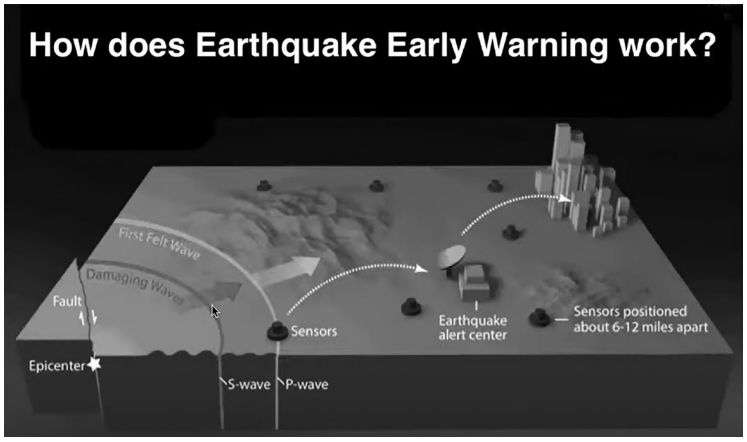
美國西海岸，尤其是加州，就處於一個板塊的邊緣線上。經常提到的就是

As to plate tectonics, we should mention a natural disaster that has been a focus especially in California — earthquakes. Dr. Tom Brocher brought us a talk about the basics about earthquakes and how we can best protect ourselves when earthquakes happen.

The first and foremost thing that Dr. Brocher emphasized, is that we shall not panic simply due to the possibilities of earthquakes. One photo he showed clearly demonstrated the power and damage of an earthquake with the damaged fences on the yard, but if we look at the houses next to the fence, we can see it is barely damaged. Actually, in an earthquake, most people are not hurt.

Yet why do earthquakes happen? Modern theories believe the earth has a core in the center, and between the core and the surface is filled by the mantle. The mantle is constantly moving, and the closer it is to the core, the hotter it becomes. Therefore, just like how hot air circulates, the mantle constantly circulates inside the earth. The mantle cools down when it gets closer to the surface, which forms the surface itself. Yet according to the theory of plate tectonics, the surface formed this way are divided into several giant plates, which also moves against each other constantly. Although the movement is very slow, it could cause collisions between plates from time to time, which then forms earthquakes. If we draw dots for all earthquakes in history onto the world map, it can clearly show the edges of the plates. Such movement not only cause earthquakes, but also may cause tsunamis. Therefore, if we just felt an earthquake shake at the sea beach, we should leave the beach immediately and get to somewhere higher within 30 minutes, so that we would not be hit by a possible tsunami that follows.

The US west coast, especially California, is right on the edge of a plate. The San Andreas fault is one that is often mentioned,



聖安德列斯地震帶，但其實還有好幾條或大或小的地震帶。通常加州平均每15年發生一次7級地震，每7年發生一次6級地震。根據灣區各地震帶的歷史概率進行綜合，接下來30年內，灣區發生一次災害性的地震的概率是72%。對洛杉磯地區來說，這個綜合概率也是72%上下。

災害性地震通常會導致房屋損傷或火災，道路受阻，缺水缺電缺食物，等等。但更要強調的一點是，地震經常還伴有餘震，而且有些時候餘震的震級能達到5或6級。所以我們要著重討論如何為地震做好準備。

準備工作可以歸納為三點：保護好自己，保護好房屋，以及獲取地震預警。

保護自己主要是防止自己在地震中受傷。通常地震中受傷主要是因為人摔倒或者被東西砸傷，所以我們可以採取三要素：臥倒，找掩護，以及抓住掩護。臥倒就不會摔傷，找桌子之類的掩護躲在下面，就不容易被東西砸到。為了能安全的移動，移動時也需要抓著桌子一起移動。

保護房屋主要是進行地震加固。1985年以後的房屋通常建造時已經有了地震加固的要求。更老的房屋通常沒有，但可以額外進行加固達到相同的保護。

but there are actually quite many large or small faults here. According to historical data, on average, California gets an M7 earthquake every 15 years, and an M6 earthquake every 7 years. When we merge all the probability numbers of the faults in the Bay Area, we predict that there is a 72% probability that the Bay Area would be hit by a damaging earthquake within the next 30 years. In the Los Angeles area, such a number is also 72%.

Damaging earthquakes usually cause house damage or start fires, damage roads, or cause water, power or food shortage. But one thing to emphasize here is that earthquakes are often followed by aftershocks, which may sometimes be M5 or even M6. So we should definitely talk about how to prepare for earthquakes.

The preparation can be summarized as three key points: protect ourselves, protect our houses, and get an early warning.

Protecting ourselves is mainly to prevent ourselves from getting hurt. This usually is caused by falling over or being hit by falling objects. So we can follow these three key terms: Drop, Cover, Hold. Drop to the ground so that you won't fall, cover yourself with a sturdy tables so that you won't be hit by falling items, and hold onto your cover when you move around to keep the protection.

Protecting our houses is mainly by retrofitting the house structures. Houses built after 1985 should already have followed the required construction code against earthquakes, and houses built before that can be strengthened by doing retrofitting work.

Early warning is to get some message about earthquakes before they bring damage. It is generally achieved by utilizing the different speed of earthquake waves. By monitoring earthquake waves, the government can detect a less-damaging and faster earthquake wave, and send warning messages before

預警則是利用地震特性提前幾秒獲得地震的信息，主要是利用地震波的速度不同來實現。通過監測地震波的狀況，政府可以在更具破壞性的地震波到來之前，給很多地區提供幾秒的預警。雖然現在人類無法預測地震，這幾秒的預警也經常可以讓人們提前做好保護。現在整個西海岸都可以使用MyShake這個官方應用程式來獲取地震預警。

然後就是建議做好一套地震預案。政府那裡還可以領取準備手冊，但主要有五點：

1. 地震中容易傾倒的重傢俱要穩固在牆體上，例如書櫃，熱水器
2. 與家庭成員制定地震時的溝通和會合方案
3. 準備一套應急物資，例如水，食品，手電，處方藥，電池等
4. 保護好財產和重要文件
5. 做好準備，一旦地震來臨，我們就能更好的保護自己，也能更好的保護和幫助周圍的人。

the more-damaging and slower earthquake wave arrives. This gives people a few seconds extra time before an earthquake actually hits. Although nowadays human beings cannot predict earthquakes, such warning, even though only being a few seconds early, can often allow people to get sufficient protection in an earthquake. Now the entire US west coast is able to use MyShake, an official app, to get such warning.

Last but not least, is that everyone is advised to create a plan for earthquakes. We can obtain a booklet about the preparations from the government, and here are the key five points:

1. Secure tall and heavy furniture or items to the wall, so that they won't fall during an earthquake. For example, bookshelves and hot water heaters.
2. Discuss with your family on how to communicate and meet up if an earthquake happens
3. Prepare a pack of emergency supplies, including water, food, flashlight, prescription drug, batteries, and so on
4. Place your financial documents etc in safe places
5. As we get ourselves ready, if the earthquake hits, we can not only better protect ourselves, but also better protect and help people around us.

—摘自宣公上人《華嚴經淺釋》華藏世界品第五

—An excerpt from Venerable Master Hsuan Hua's Commentary on Chapter Five, "The Flower Treasury Adorned Sea of Worlds"of the *Avatamsaka Sutra*

因爲眾生業力不同。才生出很多不同的諸佛剎土。因爲眾生的業力重，所以世界也就變成很多；若眾生的業盡了，佛剎國土也都會空的。一切世界在這個虛空裡邊，或者是被風輪所攝持著。或者是由水輪來支持。

. . .

在每個眾生的心念中，現出無量無邊的佛剎。因爲眾生的心念多，所現出的諸佛剎土也多。有的佛剎是用泥土所成就的。好像娑婆世界，就是泥土金石所成。可是其體性很堅固又強硬。又有佛剎是黑暗，沒有日月的光所照，猶如地獄，這是專造惡業的眾生所居住的世界。

有的佛剎是用金剛所成就，可是一半是

The power of karma of living beings creates different shapes and forms of worlds. The greater the power of karma, the more worlds there are. That is why it is said, "Many *kshetra* lands are produced by the power of karma of living beings." Only when the power of karma is completely exhausted will the *kshetras*, countries, and lands be empty. These worlds are supported by wind wheels, or maybe by water wheels.

Living beings have countless thoughts, and so do the Buddha *kshetras* that emerge from them. There are *kshetras* made of earth, with a solid and hard substance. Some Buddha *kshetras* and worlds, such as our Saha World, are made of earth. Our planet is composed of earth, stones, metals, and mud, and it is very tough. There are also dark *kshetra* lands just like the hells. This is where those with evil karma live in darkness and gloom, without any light. Such places are the abodes of living

清淨，一半是染汚。因爲雜染不純，所以有大憂怖。這種世界，苦多而樂少，是薄福眾生所居的世界。

我們生在佛後，就是薄福眾生。佛在世的時候，所有的清水，比現在的牛奶還有營養。現在所飲的牛奶，不如佛住世時的清水那樣的芬香，爲什麼？因爲我們的福根薄了，所以世界一天比一天多災多難。

或者有諸佛刹土，是用金、銀、琉璃、玻璃、硨磲、赤珠、瑪瑙七寶所和合而成（極樂世界，就是七寶合成）。又有種種莊嚴清淨的宮殿，這是因爲你修清淨的業而得到的。

. . .

我們現在這個世界，空氣都染污了。空氣怎樣染污的呢？有的說是由原子彈、氫氣彈和汽車、輕工業、重工業所排出來的煙造成的。不錯，是這樣子。但是最主要的還是由於我們人的染污心太重了，裡邊染污得太厲害了，外邊的空氣也就不新鮮了。外邊的空氣不新鮮了，裡邊也就生出很多染污的思想。所以最要緊的就是這個心。心裡不乾淨了，所以整個宇宙、法界都染污了。如果心裡能清淨了，空氣的不清淨就能化爲烏有。我們人心裡不清淨，就把整個世界也都弄邋遢了，所以現在最要緊的是清淨這個心。心清淨了，這一切也就清淨了。人心裡沒有那麼多的妄想，這個世界也就平安了；心裡沒有那麼多戰爭，世界上也就沒有戰爭了。一切唯心造，現在這個世界的一切一切，都是由眾生的心念所造成的。❁

beings with evil karma.

Some *kshetras* and countries are made of vajra, but they are half polluted and full of fear. They are not pure, but tainted with defilement. They are places of anxiety and terror, where suffering is common and bliss is scarce. Those who live there have little blessings and happiness. They are always worried, afraid, and unhappy.

People who miss the chance to see a Buddha have few blessings. When the Buddha was alive, the water people drank was more nutritious than the milk we drink today. Why is that? It's because our blessings diminish and our anxiety grows every day. That's why there are more troubles and disasters as time passes.

Some Buddha kshetras and countries are composed of the seven treasures, which are gold, silver, lapis lazuli, crystal, mother of pearl, red pearls, and carnelian. These seven gems form these worlds. (The land of ultimate bliss is composed of the seven gems). They also have various kinds of palaces. These are the results of pure karma. The living beings in these worlds have pure karma because they have practiced virtuous deeds.

. . .

The air on the earth's surface is polluted by the fumes from atomic bombs, hydrogen bombs, cars, factories, and other industries. But the impure thoughts of humans have an even bigger impact on the atmosphere. This inner impurity makes the air stale, which then leads to more impure thoughts. If the mind is not pure, it will fill the universe—the Dharma Realm—with its impurity. This mental impurity pollutes the air and darkens the world.

Now the most essential thing is to purify our minds. If our minds are purified, then everything will become pure. A mind with few false thoughts will bring peace to the world, and a mind with no conflicts will make the world free from wars. Everything in the world is created by the mind. ❁