```
//kittitorn kasemkitwatana
//studies for project at ENSCI-les ateliers
//master in Design and contemporary technology (ctc)
//subject of impermanence
//mathematics and buddhism
//e-mail : kittitorn.kasemkitwatana@ensci.com



                    void setup () {
                      size (600,800);
                    }

                    void draw () {
                      //background in black
                      background (0) ;
                      //draw the main circle
                      ellipse (300,300,300,300);
                      stroke (255);
                      fill (0);

                      //draw a series of circles
                      int numberOfcircles=12;
                      float angle=2*PI/numberOfcircles;


                      //repeat
                      for(int i=0;i<numberOfcircles;i++) {
                        float x=300 + 150*cos(angle*i); //calculus of x
                        float y=300 + 150*sin(angle*i); //calculus of x
                        //condition to the width
                        if (i%3==0) {
                          ellipse (x,y,30,30);
                          stroke (255);
                          fill (0);
                        }else{
                          ellipse (x,y,10,10);
                          stroke (255);
                          fill (0);

                        }

                      }

                    }
```

table of content;

introduction;

acknowledgement

This paper will study the relationship between mathematics and religion from the perspective of reason and the role played by reason in human knowledge. Firstly, I will study the relationship between logic and mathematics. From this starting point, I will study the relationship between reason and natural science and finally, I will draw some conclusions on the relationship between reason and philosophy. I have an idea from how to use mathematics and logic to create forms in buddhism and all the topic in this paper will be the part that helps me explore to work on my final project.

religions and mathematics

JUDISM

Maimonides

Moshe ben Maimon, or Mūsā ibn Maymūn, acronymed Rambam , and Graecized (and subsequently Latinized) Moses Maimonides (/maɪˈmɒnɪdiːz/ my--mon--i--deez), a preeminent medieval Sephardic Jewish philosopher and astronomer, became one of the most prolific and influential Torah scholars and physicians of the Middle Ages. Born in Cordova, Almoravid Empire (present--day Spain) on Passover Eve, 1135 or 1138, he died in Egypt on December 12, 1204, whence his body was taken to the lower Galilee and buried in Tiberias. He worked as a rabbi, physician, and philosopher in Morocco and Egypt.

During his lifetime, most Jews greeted Maimonides' writings on Jewish law and ethics with acclaim and gratitude, even as far away as Iraq and Yemen, and although Maimonides rose to become the revered head of the Jewish community in Egypt, there were also vociferous critics of some of his writings, particularly in Spain. Nonetheless, he was posthumously acknowledged as among the foremost rabbinical arbiters and philosophers in Jewish history, and his copious work comprises a cornerstone of Jewish scholarship. His fourteen--volume Mishneh Torah still carries significant canonical authority as a codification of Talmudic law. He is sometimes known as "ha Nesher ha Gadol" (the great eagle) in recognition of his outstanding status as a bona fide exponent of the Oral Torah.

Aside from being revered by Jewish historians, Maimonides also figures very prominently in the history of Islamic aznd Arab sciences and is mentioned extensively in studies. Influenced by Al--Farabi (ca. 872-950/951), Avicenna (c.980-1037), and his contemporary Averroes (1126-1198), he in his turn influenced other prominent Arab and Muslim philosophers and scientists. He became a prominent philosopher and polymath in both the Jewish and Islamic worlds.

MAIMONIDES

A twelfth--century rabbi and community leader, philosopher and physician, Maimonides was fascinated by the relation between science and religion from his earliest days. A polymath by inclination, he needed first to master the sciences then extant, includ-

ing logic, mathematics and medicine, before being able to assess their relation to his Jewish faith. Indeed, he insisted on philosophy's mediating role in the mutual illumination of faith and reason, notably with regard to creation.

EARLY LIFE AND INFLUENCES

Mosheh ben Maimon, called Maimonides by Latin authors and known to the Arabic--speaking world as Musa ben Maimun, Moses son of Maimon, was born on March 30, 1135 c.e., in the city of Córdoba, Spain, where eight generations of his ancestors had served as rabbis and rabbinical judges. Capital of the Umayyad emirs and caliphs in Spain since the eighth century, Córdoba had remained even in their political decline the center of a brilliant, prosperous civilization in which Jews and Christians, as well as Muslims, were active participants. Young Moses himself was not to enjoy this cosmopolitan milieu much past his bar mitzvah, as the family was forced to flee their home in the wake of the Almohads from North Africa, who forbade Jews or Christians to profess their religion openly. Yet in the relative calm prior to the shattering of their world, the Jews of Spain had built an intellectual capital from which Maimonides was to profit immeasurably, even after the world that had produced it ceased to exist.

Poetry, astronomy, medicine, philosophy, scriptural exegesis, grammar, history, and mysticism were typically integrated into a comprehensive education. Moses's father, Maimon, led the family to Fez (in present--day Morocco), the very center of the Almohad movement, where they managed to survive for five years, only to move on to Palestine in 1165, where Maimonides journeyed to the site of the temple in Jerusalem to give thanks for the gift of this pilgrimage, and thence to Hebron, the traditional resting place of Abraham, who held a special place in Maimonides's vision of history, not only as the first spokesperson of a universal monotheism, but also as the first to base theological claims on arguments derived from reason. Since the rule of the Latin Kingdom of Jerusalem offered a less than favorable milieu for developing Jewish life and culture, the family proceeded to Egypt, where Maimon soon died, leaving his son to take up the roles in the community to which his learning entitled him.

LEGAL AND PHILOSOPHICAL WRITINGS

Remarkably, Maimonides continued his education under the stress of exile and travel, composing his commentary on the Jewish legal canon, the Mishnah, during the seven years of exile from his twenty--third to thirtieth years. Taking up residence in Fustat (Old Cairo), he was appointed judge of the rabbinical court and soon assumed leadership of the community. After the death of his brother and the loss of the family savings in a shipwreck, Maimonides took up the responsibility of supporting the family as a physician, practicing medicine until his death. During this time he was court physician to Saladin (c. 1137–1193), the Sultan of Egypt and Syria, as well as the entire court, leaving him little time to study and write, yet he accomplished both, along with adjudicating disputes within the Jewish community. The completion of his groundbreaking codification of Jewish law, the Mishneh Torah, around 1178, brought him even greater fame that his earlier commentary, and he was beset with requests for legal opinions from communities throughout the Islamic world.

At this time, however, he also encountered Rabbi Joseph ibn Judah Aqnin, who insisted Maimonides guide him into the logic, cosmology, theology, and philosophy of the Greco--Arabic tradition, so as to be able to converse with other learned communities in the Islamicate. Following a course of study as old as Plato's Academy in the fourth century b.c.e., Maimonides initiated his student into astronomy and mathematics, and then logic, and finally metaphysics, by using its tools to explicate the conundra the revealed texts often left to readers of the Hebrew scriptures. This series of exercise in biblical interpretation and philosophical exegesis was published in 1190 as the Guide to the Perplexed. It was immediately translated from Arabic into Hebrew, and then into Latin, where it served as a model for Christian thinkers like Thomas Aquinas (c. 1225–1274) to integrate assertions of faith with explorations of reason.

Science and religion

The most vexing issue turned out to be the claim of Genesis that time itself began with creation, whereas the prevailing philosophical view had long been of a universe emanating necessarily and without beginning from a single unitary principle. Maimonides established the model for addressing this conflict between the

divergent claims of reason and of faith by using his philosophical acumen to show that the authority whom philosophers had invoked--Aristotle--had neither intended nor achieved a demonstration of the universe coming forth from a single unitary principle without beginning. And having shown that, he proceeded to delineate the anomalies in the actual universe, notably the errant path of the planets (or “wandering stars”), to point out that no set of logical principles could account for the actual ordering of the heavens, despite the elegance of the necessary emanation scheme. So, he said, it makes more eminent sense to posit a free creator, whose intentional ordering could explain what logic cannot.

This central bit of reasoning displays how his scientific acumen could be put to use to make it possible for believers to accept the words of Genesis at face value, yet he was also quick to insist that neither view could be proven. Moreover, where scriptural texts did conflict with proven tenets of reason, then they would have to be interpreted figuratively; since the divine reality could not be bodily, texts referring to the “Lord’s mighty arm” would have to be read metaphorically. He was even prepared to read Genesis that way, foregoing a first moment of time for creation, but the absence of a valid demonstration of the prevailing philosophical view reduced it to the level of mere opinion--however widely held it had been, and so opened the way to a belief in scripture that was straightforward yet sophisticated. Such is the legacy that all religious traditions received from Maimonides, whose strategies were transmitted to the Christian world by way of Aquinas and others after him. In short, what seem to be conflicts between faith and reason, religion and science, may often be defused by a proper understanding of each domain, yet doing so requires an education and a sensibility as astute as Moses Maimonides’s. As the celebrated Hebrew saying has it: “from Moses to Moses, there arose none like Moses.”

SYSTEM KABBALAH

Kabbalah is an ancient wisdom that reveals how the universe and life work. On a literal level, the word Kabbalah means “to receive.” It’s the study of how to receive fulfillment in our lives.

Most of us, at some point in our life, have been overcome with the feeling that we are not as fulfilled as we could be. Paradoxically, often the harder we strive to achieve that fulfillment, the more it eludes us.

When we speak about fulfillment, we don’t mean just being temporarily happy or experiencing fleeting senses of wellbeing. We mean connecting to the energy, and maintaining our connection to true long--lasting fulfillment.

Kabbalah is an ancient paradigm for living. It teaches that all of the branches of our lives -- health, relationships, careers -- emanate from the same trunk and the same root. It’s the technology of how the universe works at the core level. It’s a way of looking at the world that can connect you to the kind of permanent fulfillment you seek.

Kabbalah teaches universal principles that apply to all peoples of all faiths and all religions, regardless of ethnicity or where you come from. The beauty of studying Kabbalah is that you can’t be forced to think in a particular way. There can be no coercion in spirituality. All we can do is simply share information with you and hope that you will apply it to your life with the intention of bettering it. That’s the purpose of everything you will discover on kabbalah.com.

The knowledge we impart, the information we provide, and the tools we share must have practical results in your life, results you can feel. Kabbalistic wisdom is not based in blind faith, but practical application. Kabbalah will deepen your understanding of the universe and give you more information and tools to understand why things are happening to you, and how you can better connect to the Light of the Creator and receive the fulfillment you’re seeking.

MUSLIM

AVÉROES

Averroës (AKA Ibn Rushd or Ibn Roschd or, in full, Abu al--Walid Muhammad ibn Ahmad ibn Rushd) (1126 -- 1198) was a Spanish--Arabic philosopher, physician, lawyer and polymath from the Andalusia region of southern Spain in the Medieval period. After his death, the Averroism movement grew up around his teachings, and his work greatly influenced the subsequent development of Scholasticism in Western Europe.

In the Islamic world, he played a decisive role in the defence of Greek philosophy against the orthodox Ash'arite theologians led by al--Ghazali (1058 -- 1111). Although during his lifetime his philosophy was considered controversial in Muslim circles, he had an even greater impact on Western European thought, and he has been described as the founding father of secular thought, becoming known as "The Commentator" in the Christian West.

LIFE

Averroës (pronounced a--VER--o--ees, the Latinized distortion of the actual Arab name Ibn Rushd) was born in 1126 in Córdoba (Cordova) in Andalusia, the capital of Muslim Spain. He came from a family of Maliki legal scholars (Maliki is one of the four schools of religious law within Sunni Islam), and both his grandfather, Abu Al--Walid Muhammad, and his father, Abu Al--Qasim Ahmad, were chief judges of Córdoba under the Almoravid dynasty which ruled the region until replaced by the Almohads in the mid--12th Century.

His early education followed a traditional path in such a family, beginning with studies in hadith, linguistics, jurisprudence and scholastic theology. He was influenced (and perhaps was once tutored) by the philosopher Ibn Bajjah (1095 -- 1138, known as Avempace in the West). His medical education was directed under Abu Jafar ibn Harun of Trujillo, and he showed a clear aptitude for medicine, (his compendium of medicine, "al--Kulliyat" became one of the main medical textbooks for physicians in the Jewish, Christian and Muslim worlds for centuries to come).

In 1169, Averroës was made a qadi (a sharia or religious judge) of Seville, and then, in 1172, chief judge of Córdova. Throughout this period of his life, he wrote many legal commentaries and treatises on legal methodology, legal pronouncements, sacrifices and land taxes.

During one of his periodic residences in Marrakesh (Marrakech), Morocco, the North African capital of the Almohad dynasty, he was befriended by Ibn Tufail (c. 1105 -- 1185, known as Abubacer in the West), a philosopher and official physician and counsellor to the caliph Abu Yaqub Yusuf. Ibn Tufail introduced Averroës to the caliph, and the prince was so impressed by the young philosopher that he employed him, first as his chief judge and later in 1182 as chief physician. He also commissioned Averroës to write a series of commentaries on the texts of Aristotle, (for whom Averroës professed the greatest esteem in all matters of science and philosophy), which became one of Averroës' main legacies to Western philosophy.

However, despite the general liberalism of the Almohad Dynasty, public pressure from the more orthodox Islamic elements under the third Almohad caliph, Abu Yusuf Ya'qub al--Mansur, led to the formal rejection of Averroës and his strictly rationalist views in 1195. He was tried as a heretic by the religious community of Córdova, exiled to Lucena (a largely Jewish village outside of Córdoba) his writings were banned and his books burned. Just two years later, shortly before his death, he was rehabilitated, despite continued doubts about his orthodoxy.

Averroës died on 10 December 1198 in Marrakesh, Morocco, and his writings found new audiences after his death, mainly in the Christian and Jewish worlds.

WORK

Averroës is perhaps most famous for his translations and detailed commentaries on the works of Aristotle, which earned for him the title of the "The Commentator". These were based on imperfect Arabic translations, not Greek originals (it is believed that he was unacquainted with Greek or Syriac), and he did not have access to some of the texts (e.g. the"Politics"). The commentaries were organized into three levels: the Jami (a simplified overview), the Talkhis (an intermediate commentary with more critical material) and the Tafsir (an advanced study of Aristotelian thought in a Muslim context).

Many of his commentaries were translated into Hebrew and then into Latin (or sometimes directly into Latin) in the 12th and 13th Century. Many of the works on Logic and Metaphysics have been permanently lost, while others, including some of the longer commentaries, have only survived in Latin or Hebrew translation, and not in the original Arabic.

The significance of these works is that, before 1150, only a few translated works of Aristotle existed in Latin Europe, and they were not studied much or given much credence by monastic scholars, and it was through the Latin translations of Averroës' work that the legacy of Aristotle became more widely known in the West, with particular importance for the Medieval Scholastic movement. Averroës also argued for the emancipation of science and philosophy from official Ash'ari Muslim theology, and some writers regard him as a precursor to modern secularism, or even the founding father of secular thought in Western Europe.

His most important original philosophical work was "Tahafut al--tahafut" ("The Incoherence of the Incoherence"), in which he defended Aristotelian philosophy against the claims of al--Ghazali in his "Tahafut al--falasifa" ("The Incoherence of the Philosophers"). Al--Ghazali had argued that Aristotelianism, especially as presented in the earlier writings of Avicenna, was self--contradictory and an affront to the teachings of Islam. Averroës contended both that al--Ghazali's arguments were mistaken, but also that, in any case, Avicenna's interpretations were a distortion of genuine Aristotelianism, so that, in effect, al--Ghazali was aiming at the wrong target.

For Averroës, there was no conflict between religion and philosophy, believing rather that they were just different ways of reaching the same truth. He identified two kinds of knowledge of truth: knowledge of truth from religion (for the unlettered multitude, based in faith and untestable); and knowledge of truth from philosophy (the real truth, but reserved for an elite few who had the intellectual capacity to undertake such study). He was bold enough to claim the superiority of reason and philosophy over faith and knowledge founded on faith, and to emphasize the independent use of reason, and the idea that the philosophical and religious worlds are separate entities.

He believed in an eternal universe, and in a soul which is divided into two parts (an individual part, and a divine part which is eternal and shared by all). His belief in the then radical idea that "existence precedes essence" was developed much later by the Transcendent Theosophy of Mulla Sadra (c. 1571 – 1640) in the 17th Century and by Existentialism in the 20th Century.

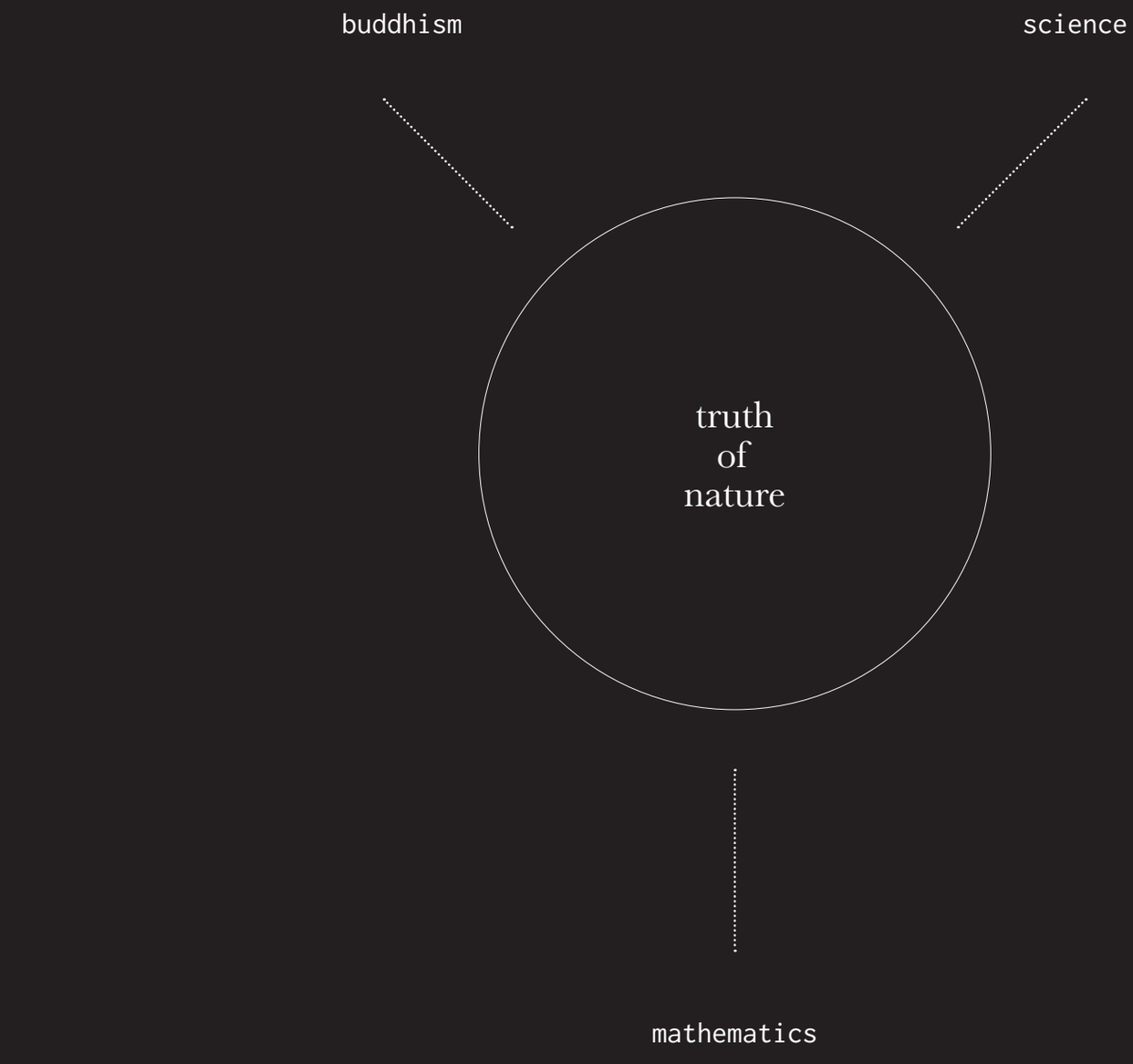
abstract

Tracing back to the time before history, humans utilise mathematics and various shapes and forms as a way to communicate through indicating amounts and quantities. Mathematics is considered as one of the most internationally recognised languages. Therefore, mathematics is an essential tool in communication or language interpretation. There are three types of visual comprehension including numbers, texts (or alphabetical characters) and images. Numbers and images or symbolic forms accordingly engage consensual understanding among humans through being explained and comprehended

Because Buddhism does not include the idea of worshipping God, the creator. Some people do not see it as a religion in the normal, Western sense. The basic tenets of Buddhist teaching are straightforward and practical: nothing is fixed or permanent; actions have consequences; changes are possible. Therefore, Buddhism addresses itself to all people irrespective of race, nationality, caste, sexuality, or gender. It teaches practical methods which enable people to realise and use those teachings in order to transform their experience, to be fully responsible for their lives.

Buddhism is a path of practice and spiritual development leading to insight into the true nature of reality. Buddhist practices like meditation are a means of changing oneself in order to develop the qualities of awareness, kindness, and wisdom. The experience developed within the Buddhist tradition over thousands of years has created an incomparable resource for all those who wish to follow a path -- a path which ultimately culminates in Enlightenment or Buddhahood. An enlightened being sees the nature of reality clearly, just as it is, and lives fully and naturally in accordance with that vision. This is the goal of the Buddhist spiritual life, representing the end of suffering for anyone who attains it. But there are many different types of Buddhism, because the emphasis changes from country to country due to customs and cultures. What does not vary is the essence of the teaching -- the Dhamma or truth. Thus, what people understand about buddhism is not the same believe in everywhere

logics



what people think about buddhism

sects of buddhism

mahayana

theravada

mathematics and art

Mathematics and art have a long historical relationship. Artists have used mathematics since the 5th century BC when the Greek sculptor Polykleitos wrote his Canon, prescribing proportions based on the ratio 1:√2 for the ideal male nude. Persistent popular claims have been made for the use of the golden ratio in ancient art and architecture, without reliable evidence. In the Italian Renaissance, Luca Pacioli wrote the influential treatise De Divina Proportione (1509), illustrated with woodcuts by Leonardo da Vinci, on the use of the golden ratio in art. Another Italian painter, Piero della Francesca, developed Euclid's ideas on perspective in treatises such as De Prospectiva Pingendi, and in his paintings. The engraver Albrecht Dürer made many references to mathematics in his work Melencolia I. In modern times, the graphic artist M. C. Escher made intensive use of tessellation and hyperbolic geometry, with the help of the mathematician H. S. M. Coxeter, while the De Stijl movement led by Theo van Doesberg and Piet Mondrian explicitly embraced geometrical forms. Mathematics has inspired textile arts such as quilting, knitting, crossstitch, crochet, embroidery, weaving, Turkish and other carpet--making, as well as kilim. In Islamic art, symmetries are evident in forms as varied as Persian girih and Moroccan zellige tilework, Mughal jaali pierced stone screens, and widespread muqarnas vaulting.

buddhism throught and mathematics

One of the many topics that was raised during the talk on the Thai translation of Matthieu Ricard's and Trinh Xuan Thuan's book concerned the relation between Buddhist thought and mathematics. There have of course been quite a lot of talks about how Buddhism and science are related, but not much at all on Buddhism and mathematics. So that was a welcome change. Unfortunately we did not spend much time on this fascinating topic.

It was credit to Ricard and Thuan that they spend one entire chapter on this topic. The idea is how mathematics is related to reality and what the Buddhists think of that. The eleventh chapter of the book is entitled "The Grammar of the Universe" or something like that. What is interesting is how mathematics is an accurate description of reality at all. Which comes first, mathematics or the world?

On the one hand, this is a very simple point. We all know that two plus two equals four. So you have two things, add another two, and count the result, which is of course four. But the premise of mathematics is that you cannot get mathematics (or logic for that matter) out of empirical observation. You just cannot form a general statement "2 + 2 = 4" from just observing two things and another two things. The reason is that you have somehow to know before hand that two plus two equals four in order for you to be able to get the conclusion that these two things and these other two make four! This is Kant's main argumentative strategy in his entire critical philosophy. And for Kant mathematics is a prime example of what he calls "synthetic a priori" judgments, e.g., judgments that are true by virtue of their correspondence with some outside measuring point but which is known entirely through thinking alone.

We are not actually discussing Kant here; the point is that if the truth of mathematics does not come from observation, then it must come from inside. Ricard and Thuan discussed that perhaps this situation implies that there is some universal and all powerful mind whose thinking made all mathematical statements true (all the true ones, of course). It is this big mind that guarantees that two plus two equals four, that two plus two equals four, that the sum of the squares on the side of the two legs of a right angle triangle is equal to that on the hypotenuse, that the law of modus ponens ('p' and 'if p then q' always implies 'q'), and so on.

So this big mind might refer to God. So here the discussion went on to see what the Buddhists think about this. I don't quite remember what Ricard, the Buddhist representative in the book, made of this, so I am going to present my own thought. I also did this during the talk last Saturday, but time was so limited then.

I think the main difference between the theistic religions like Christianity and Islam and non--theistic one like Buddhism might not appear as large as one might think. Buddhism would have no problem recognising the Big Mind alluded to above, so long as that refers, not to some external being, but in fact to our own minds. It is us who create mathematics and it is ultimately speaking our own minds, working together collectively, that create the world such that it is true of mathematics. In other words, we could also say that we human beings are gods unto ourselves. There is a Big Mind that creates reality corresponding to math, yes, but that Mind is not apart from us.

Whether this is shocking or not depends on your view on theism. If you believe that humans are apart from God, then you'd find this shocking. However, this is entirely correspondent with the Buddhist attitude that salvation is ultimately the person's own responsibility and lies entirely within the person's power to achieve. The Buddha is only a teacher. You don't need to follow his teaching. The Buddha has no power to drag you to Liberation. No being does. You have to do it yourself.

Coming down from theological discussion and back down to earth, we see that the idea that it is human mind itself that creates mathematics to which reality belongs makes quite a lot of sense. We form mathematics and we perceive the world according to the same conceptual structure that formed the math in the first place, so no wonder the world corresponds to it. However, even thought mathematics looks very certain, it does not describe what reality is like ultimately speaking. This is because all mathematics depends on concepts and language (so is logic), and once you have concepts, you have to divide reality into separate chunks. So at best mathematics is a model or a map, and no map can become identical to the reality it is the map of. This refers to the doctrine of Emptiness or sunyata. We can say that math can always approach that, but never reach it, because if it does, then it would cease to be the math that it is.

six aspects of mathematics which are relevant to buddhist philosophy

(i) The foundations of mathematics have parallels (and differences) with the Buddhist concept of emptiness (sunyata)

(ii) The bootstrapping of the integers out of the empty set provides a simple illustration of how causes and components can be expressed as algorithms and data-- structures.

(iii) The further development of mathematics from its empty foundations creates computational algorithms and data structures that can simulate all physical phenomena.

(iv) These simulations epitomise the ‘unreasonable effectiveness’ of mathematics in physics and engineering, which suggests that there may be aspects of the mind which are not explainable as the products of evolution.

(v) The concept of ‘algorithmic compression’, which is an aspect of the unreasonable effectiveness of mathematics, leads on to the Church--Turing--Deutsch principle, which gives us a workable philosophical demarcation between physical and non--physical phenomena, including physical and non--physical aspects of the mind.

(vi) The deep interconnection between the mind contemplating emptiness, and the workings of the physical world, suggests that mathematics may provide a bridge between ultimate and conventional truths.

history;

mathematics

euclid

Euclid sometimes called Euclid of Alexandria to distinguish him from Euclid of Megara, was a Greek mathematician, often referred to as the “father of geometry”. He was active in Alexandria during the reign of Ptolemy I (323--283 BCE). His Elements is one of the most influential works in the history of mathematics, serving as the main textbook for teaching mathematics (especially geometry) from the time of its publication until the late 19th or early 20th century. In the Elements, Euclid deduced the principles of what is now called Euclidean geometry from a small set of axioms. Euclid also wrote works on perspective, conic sections, spherical geometry, number theory and rigor.

Mathematicians seek out patterns and use them to formulate new conjectures. Mathematicians resolve the truth or falsity of conjectures by mathematical proof. When mathematical structures are good models of real phenomena, then mathematical reasoning can provide insight or predictions about nature. Through the use of abstraction and logic, mathematics developed from counting, calculation, measurement, and the systematic study of the shapes and motions of physical objects. Practical mathematics has been a human activity for as far back as written records exist. The research required to solve mathematical problems can take years or even centuries of sustained inquiry.

Mathematics is essential in many fields, including natural science, engineering, medicine, finance and the social sciences. Applied mathematics has led to entirely new mathematical disciplines, such as statistics and game theory. Mathematicians also engage in pure mathematics, or mathematics for its own sake, without having any application in mind. There is no clear line separating pure and applied mathematics, and practical applications for what began as pure mathematics are often discovered.

As the Greek empire began to spread its sphere of influence into Asia Minor, Mesopotamia and beyond, the Greeks were smart enough to adopt and adapt useful elements from the societies they conquered. This was as true of their mathematics as anything else, and they adopted elements of mathematics from both the Babylonians and the Egyptians.

But they soon started to make important contributions in their own right and, for the first time, we can acknowledge contributions by individuals. By the Hellenistic period, the Greeks had presided over one of the most dramatic and important revolutions in mathematical thought of all time.

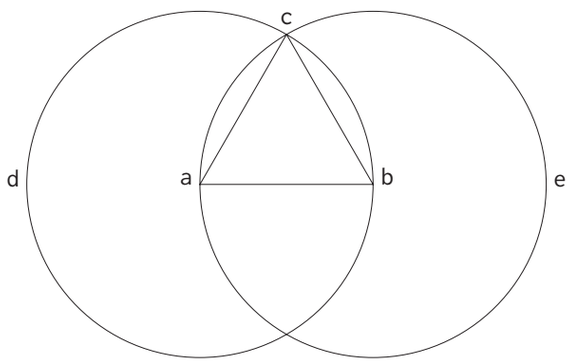
The ancient Greek numeral system, known as Attic or Herodianic numerals, was fully developed by about 450 BCE, and in regular use possibly as early as the 7th Century BCE. It was a base 10 system similar to the earlier Egyptian one (and even more similar to the later Roman system), with symbols for 1, 5, 10, 50, 100, 500 and 1,000 repeated as many times needed to represent the desired number. Addition was done by totalling separately the symbols (1s, 10s, 100s, etc) in the numbers to be added, and multiplication was a laborious process based on successive doublings (division was based on the inverse of this process).

But most of Greek mathematics was based on geometry. Thales, one of the Seven Sages of Ancient Greece, who lived on the Ionian coast of Asian Minor in the first half of the 6th Century BCE, is usually considered to have been the first to lay down guidelines for the abstract development of geometry, although what we know of his work (such as on similar and right triangles) now seems quite elementary.

The Greek mathematician Euclid lived and flourished in Alexandria in Egypt around 300 BCE, during the reign of Ptolemy I. Almost nothing is known of his life, and no likeness or first--hand description of his physical appearance has survived antiquity, and so depictions of him (with a long flowing beard and cloth cap) in works of art are necessarily the products of the artist's imagination.

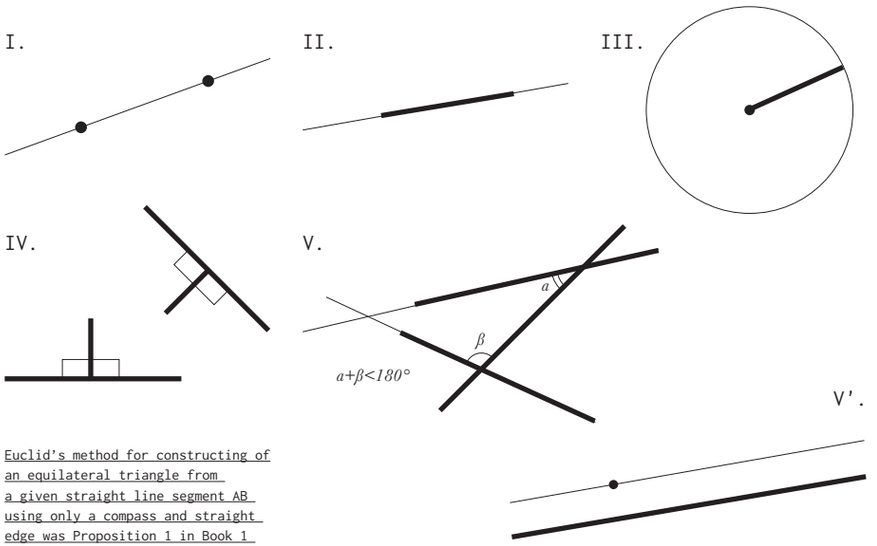
He probably studied for a time at Plato's Academy in Athens but, by Euclid's time, Alexandria, under the patronage of the Ptolemies and with its prestigious and comprehensive Library, had already become a worthy rival to the great Academy.

Euclid is often referred to as the "Father of Geometry", and he wrote perhaps the most important and successful mathematical textbook of all time, the "Stoicheion" or "Elements", which represents the culmination of the mathematical revolution which had taken place in Greece up to that time. He also wrote works on the division of geometrical figures into into parts in given ratios, on catoptrics (the mathematical theory of mirrors and reflection), and on spherical astronomy (the determination of the location of objects on the "celestial sphere"), as well as important texts on optics and music.



Euclid's method for constructing of an equilateral triangle from a given straight line segment AB using only a compass and straight edge was Proposition 1 in Book 1 of the Elements Euclid's method for constructing of an equilateral triangle from a given straight line segment AB using only a compass and straight edge was Proposition 1 in Book 1 of the Elements

The "Elements" was a lucid and comprehensive compilation and explanation of all the known mathematics of his time, including the work of Pythagoras, Hippocrates, Theudius, Theaetetus and Eudoxus. In all, it contains 465 theorems and proofs, described in a clear, logical and elegant style, and using only a compass and a straight edge. Euclid reworked the mathematical concepts of his predecessors into a consistent whole, later to become known as Euclidean geometry, which is still as valid today as it was 2,300 years ago, even in higher mathematics dealing with higher dimensional spaces. It was only with the work of Bolyai, Lobachevski and Riemann in the first half of the 19th Century that any kind of non--Euclidean geometry was even considered. The "Elements" remained the definitive textbook on geometry and mathematics for well over two millennia, surviving the eclipse in classical learning in Europe during the Dark Ages through Arabic translations. It set, for all time, the model for mathematical argument, following logical deductions from initial assumptions (which Euclid called "axioms" and "postulates") in order to establish proven theorems.



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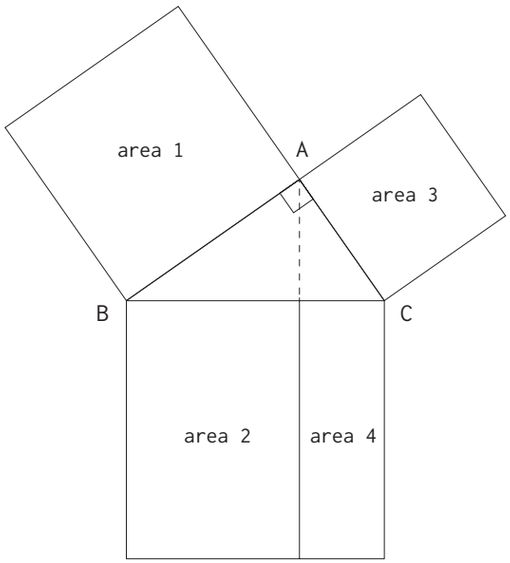


area 1 = area 2
area 3 = area 4

Euclid's proof of Pythagoras Theorem revolved around the fact that if a line is draw from the right angle, perpendicular to the hypotenuse and draw through the square on the hypotenuse that square is split into two rectangle each having the same area as the squares on the other two sides

Euclid's five general axioms were:

- Things which are equal to the same thing are equal to each other.
- If equals are added to equals, the wholes (sums) are equal.
- If equals are subtracted from equals, the remainders (differences) are equal.
- Things that coincide with one another are equal to one another.
- The whole is greater than the part.

His five geometrical postulates were:

- It is possible to draw a straight line from any point to any point.
- It is possible to extend a finite straight line continuously in a straight line (i.e. a line segment can be extended past either of its endpoints to form an arbitrarily large line segment).
- It is possible to create a circle with any center and distance (radius).
- All right angles are equal to one another (i.e. "half" of a straight angle).
- If a straight line crossing two straight lines makes the interior angles on the same side less than two right angles, the two straight lines, if produced indefinitely, meet on that side on which the angles are less than the two right angles.

Among many other mathematical gems, the thirteen volumes of the "Elements" contain formulas for calculating the volumes of solids such as cones, pyramids and cylinders; proofs about geometric series, perfect numbers and primes; algorithms for finding the greatest common divisor and least common multiple of two numbers; a proof and generalisation of Pythagoras' Theorem, and proof that there are an infinite number of Pythagorean Triples; and a final definitive proof that there can be only five possible regular Platonic Solids.

However, the "Elements" also includes a series of theorems on the properties of numbers and integers, marking the first real beginnings of number theory. For example, Euclid proved what has become known as the Fundamental Theorem of Arithmetic (or the Unique Factorisation Theorem), that every positive integer greater than 1 can be written as a product of prime numbers (or is itself a prime number). Thus, for example: 21 = 3 x 7; 113 = 1 x 113; 1,200 = 2 x 2 x 2 x 2 x 3 x 5 x 5; 6,936 = 2 x 2 x 2 x 3 x 17 x 17; etc. His proof was the first known example of a proof by contradiction (where any counter--example, which would otherwise prove an idea false, is shown to makes no logical sense itself).

He was the first to realize -- and prove -- that there are infinitely many prime numbers. The basis of his proof, often known as Euclid's Theorem, is that, for any given (finite) set of primes, if you multiply all of them together and then add one, then a new prime has been added to the set (for example, 2 x 3 x 5 = 30, and 30 + 1 = 31, a prime number) a process which can be repeated indefinitely.

Euclid also identified the first four "perfect numbers", numbers that are the sum of all their divisors (excluding the number itself):
6 = 1 + 2 + 3;
28 = 1 + 2 + 4 + 7 + 14;
496 = 1 + 2 + 4 + 8 + 16 + 31 + 62 + 124 + 248; and
8,128 = 2 + 4 + 8 + 16 + 32 + 64 + 127 + 254 + 508 + 1,016 + 2,032 + 4,064.

He noted that these numbers also have many other interesting properties. For example: They are triangular numbers, and therefore the sum of all the consecutive numbers up
to their largest prime factor: 6 = 1 + 2 + 3; 28 = 1 + 2 + 3 + 4 + 5 + 6 + 7; 496 = 1 + 2 + 3 + 4 + 5 + ... + 30 + 31; 8,128 = 1 + 2 + 3 + 4 + 5 + ... + 126 + 127.
Their largest prime factor is a power of 2 less one, and the number is always a product of this number and the previous power of two: 6 = 21(22 -- 1); 28 = 22(23 -- 1); 496 = 24(25 -- 1); 8,128 = 26(27 -- 1).

Although the Pythagoreans may have been aware of the Golden Ratio (φ, approximately equal to 1.618), Euclid was the first to define it in terms of ratios (AB:AC = AC:CB), and demonstrated its appearance within many geometric shapes.

golden ratio

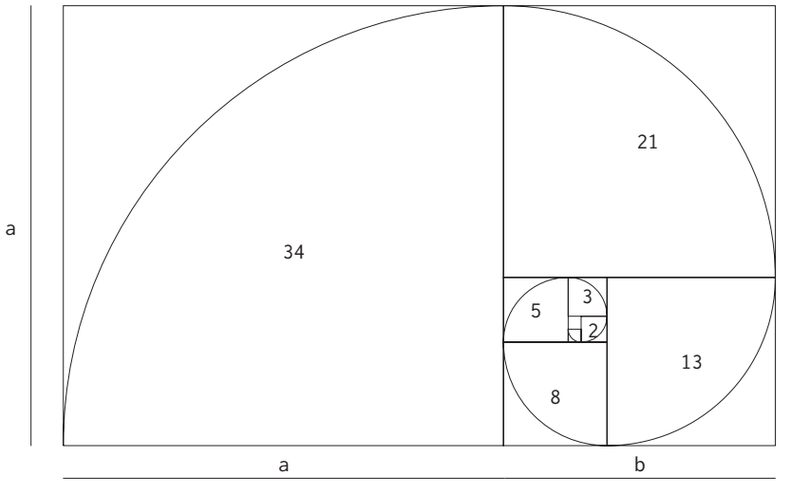
The Golden ratio is a special number found by dividing a line into two parts so that the longer part divided by the smaller part is also equal to the whole length divided by the longer part. It is often symbolised using phi, after the 21st letter of the Greek alphabet. In an equation form, it looks like this:

a/b = (a+b)/a = 1.6180339887498948420 …

As with pi (the ratio of the circumference of a circle to its diameter), the digits go on and on, theoretically into infinity. Phi is usually rounded off to 1.618. This number has been discovered and rediscovered many times, which is why it has so many names -- the Golden mean, the Golden section, divine proportion, etc. Historically, the number can be seen in the architecture of many ancient creations, like the Great Pyramids and the Parthenon. In the Great Pyramid of Giza, the length of each side of the base is 756 feet with a height of 481 feet. The ratio of the base to the height is roughly 1.5717, which is close to the Golden ratio.

Around 1200, mathematician Leonardo Fibonacci discovered the unique properties of the Fibonacci sequence. This sequence ties directly into the Golden ratio because if you take any two successive Fibonacci numbers, their ratio is very close to the Golden ratio. As the numbers get higher, the ratio becomes even closer to 1.618. For example, the ratio of 3 to 5 is 1.666. But the ratio of 13 to 21 is 1.625. Getting even higher, the ratio of 144 to 233 is 1.618. These numbers are all successive numbers in the Fibonacci sequence.

These numbers can be applied to the proportions of a rectangle, called the Golden rectangle. This is known as one of the most visually satisfying of all geometric forms -- hence, the appearance of the Golden ratio in art. The Golden rectangle is also related to the Golden spiral, which is created by making adjacent squares of Fibonacci dimensions.



In 1509, Luca Pacioli wrote a book that refers to the number as the “Divine Proportion”, which was illustrated by Leonardo da Vinci. Da Vinci later called this sectio aurea or the Golden section. The Golden ratio was used to achieve balance and beauty in many Renaissance paintings and sculptures. Da Vinci himself used the Golden ratio to define all of the proportions in his Last Supper, including the dimensions of the table and the proportions of the walls and backgrounds. The Golden ratio also appears in da Vinci’s Vitruvian Man and the Mona Lisa. Other artists who employed the Golden ratio include Michelangelo, Raphael, Rembrandt, Seurat, and Salvador Dali.

The term “phi” was coined by American mathematician Mark Barr in the 1900s. Phi has continued to appear in mathematics and physics, including the 1970s Penrose Tiles, which allowed surfaces to be tiled in five--fold symmetry. In the 1980s, phi appeared in quasi crystals, a then--newly discovered form of matter.

Phi is more than an obscure term found in mathematics and physics. It appears around us in our daily lives, even in our aesthetic views. Studies have shown that when test subjects view random faces, the ones they deem most attractive are those with solid parallels to the Golden ratio.

Faces judged as the most attractive show Golden ratio proportions between the width of the face and the width of the eyes, nose, and eyebrows. The test subjects weren’t mathematicians or physicists familiar with phi -- they were just average people, and the Golden ratio elicited an instinctual reaction.

The Golden ratio also appears in all forms of nature and science. Some unexpected places include: Flower petals: The number of petals on some flowers follows the Fibonacci sequence. It is believed that in the Darwinian processes, each petal is placed to allow for the best possible exposure to sunlight and other factors.

Seed heads: The seeds of a flower are often produced at the center and migrate outward to fill the space. For example, sunflowers follow this pattern.

Pinecones: The spiral pattern of the seed pods spiral upward in opposite directions. The number of steps the spirals take tend to match Fibonacci numbers.

Tree branches: The way tree branches form or split is an example of the Fibonacci sequence. Root systems and algae exhibit this formation pattern.

Shells: Many shells, including snail shells and nautilus shells, are perfect examples of the Golden spiral.

Spiral galaxies: The Milky Way has a number of spiral arms, each of which has a logarithmic spiral of roughly 12 degrees. The shape of the spiral is identical to the Golden spiral, and the Golden rectangle can be drawn over any spiral galaxy.

Hurricanes: Much like shells, hurricanes often display the Golden spiral.

Fingers: The length of our fingers, each section from the tip of the base to the wrist is larger than the preceding one by roughly the ratio of phi.

Animal bodies: The measurement of the human navel to the floor and the top of the head to the navel is the Golden ratio. But we are not the only examples of the Golden ratio in the animal kingdom; dolphins, starfish, sand dollars, sea urchins, ants and honeybees also exhibit the proportion.

DNA molecules: A DNA molecule measures 34 angstroms by 21 angstroms at each full cycle of the double helix spiral. In the Fibonacci series, 34 and 21 are successive numbers.

physics

Physics (from Ancient Greek: φυσική phusikḗ (epistḗmē) “knowledge of nature”, from φύσις phúsis “nature”) is the natural science that involves the study of matter and its motion through space and time, along with related concepts such as energy and force. One of the most fundamental scientific disciplines, the main goal of physics is to understand how the universe behaves.

Physics is one of the oldest academic disciplines, perhaps the oldest through its inclusion of astronomy. Over the last two millennia, physics was a part of natural philosophy along with chemistry, biology, and certain branches of mathematics, but during the scientific revolution in the 17th century, the natural sciences emerged as unique research programs in their own right. Physics intersects with many interdisciplinary areas of research, such as biophysics and quantum chemistry, and the boundaries of physics are not rigidly defined. New ideas in physics often explain the fundamental mechanisms of other sciences while opening new avenues of research in areas such as mathematics and philosophy.

Physics also makes significant contributions through advances in new technologies that arise from theoretical breakthroughs. For example, advances in the understanding of electromagnetism or nuclear physics led directly to the development of new products that have dramatically transformed modern--day society, such as television, computers, domestic appliances, and nuclear weapons; advances in thermodynamics led to the development of industrialisation, and advances in mechanics inspired the development of calculus.

logic

(from the Ancient Greek: λογική, logike) is the branch of philosophy concerned with the use and study of valid reasoning.The study of logic also features prominently in mathematics and computer science.

Logic was studied in several ancient civilizations, including Greece, India, and China. In the West, logic was established as a formal discipline by Aristotle, who gave it a fundamental place in philosophy. The study of logic was part of the classical trivium, which also included grammar and rhetoric. Logic was further extended by Al--Farabi who categorized it into two separate groups (idea and proof). Later, Avicenna revived the study of logic and developed relationship between temporalis and the implication. In the East, logic was developed by Hindus, Buddhists and Jains.

Logic is often divided into three parts: inductive reasoning, abductive reasoning, and deductive reasoning.

The concept of logical form is central to logic. The validity of an argument is determined by its logical form, not by its content. Traditional Aristotelian syllogistic logic and modern symbolic logic are examples of formal logic.

Informal logic is the study of natural language arguments. The study of fallacies is an important branch of informal logic. The dialogues of Plato are good examples of informal logic.

Formal logic is the study of inference with purely formal content. An inference possesses a purely formal content if it can be expressed as a particular application of a wholly abstract rule, that is, a rule that is not about any particular thing or property. The works of Aristotle contain the earliest known formal study of logic. Modern formal logic follows and expands on Aristotle. In many definitions of logic, logical inference and inference with purely formal content are the same. This does not render the notion of informal logic vacuous, because no formal logic captures all of the nuances of natural language.

classical physics

Sir Isaac Newton (1643--1727), whose laws of motion and universal gravitation were major milestones in classical physics.

Physics became a separate science when early modern Europeans used experimental and quantitative methods to discover what are now considered to be the laws of physics.

Major developments in this period include the replacement of the geocentric model of the solar system with the helio--centric Copernican model, the laws governing the motion of planetary bodies determined by Johannes Kepler between 1609 and 1619, pioneering work on telescopes and observational astronomy by Galileo Galilei in the 16th and 17th Centuries, and Isaac Newton's discovery and unification of the laws of motion and universal gravitation that would come to bear his name. Newton also developed calculus, the mathematical study of change, which provided new mathematical methods for solving physical problems.

The discovery of new laws in thermodynamics, chemistry, and electromagnetics resulted from greater research efforts during the Industrial Revolution as energy needs increased. The laws comprising classical physics remain very widely used for objects on everyday scales travelling at non--relativistic speeds, since they provide a very close approximation in such situations, and theories such as quantum mechanics and the theory of relativity simplify to their classical equivalents at such scales. However, inaccuracies in classical mechanics for very small objects and very high velocities led to the development of modern physics in the 20th century.

modern physics

Albert Einstein (1879--1955), whose work on the photoelectric effect and the theory of relativity led to a revolution in 20th century physics

Max Planck (1858--1947), the originator of the theory of quantum mechanics Modern physics began in the early 20th century with the work of Max Planck in quantum theory and Albert Einstein's theory of relativity. Both of these theories came about due to inaccuracies in classical mechanics in certain situations. Classical mechanics predicted a varying speed of light, which could not be resolved with the constant speed predicted by Maxwell's equations of electromagnetism; this discrepancy was corrected by Einstein's theory of special relativity, which replaced classical mechanics for fast--moving bodies and allowed for a constant speed of light. Black body radiation provided another problem for classical physics, which was corrected when Planck proposed that light comes in individual packets known as photons; this, along with the photoelectric effect and a complete theory predicting discrete energy levels of electron orbitals, led to the theory of quantum mechanics taking over from classical physics at very small scales.

Quantum mechanics would come to be pioneered by Werner Heisenberg, Erwin Schrödinger and Paul Dirac. From this early work, and work in related fields, the Standard Model of particle physics was derived. Following the discovery of a particle with properties consistent with the Higgs boson at CERN in 2012, all fundamental particles predicted by the standard model, and no others, appear to exist; however, physics beyond the Standard Model, with theories such as supersymmetry, is an active area of research. Areas of mathematics in general are important to this field, such as study of probabilities.

logical forms

Logic is generally considered formal when it analyzes and represents the form of any valid argument type. The form of an argument is displayed by representing its sentences in the formal grammar and symbolism of a logical language to make its content usable in formal inference. If one considers the notion of form too philosophically loaded, one could say that formalizing simply means translating English sentences into the language of logic.

This is called showing the logical form of the argument. It is necessary because indicative sentences of ordinary language show a considerable variety of form and complexity that makes their use in inference impractical. It requires, first, ignoring those grammatical features irrelevant to logic (such as gender and declension, if the argument is in Latin), replacing conjunctions irrelevant to logic (such as “but”) with logical conjunctions like “and” and replacing ambiguous, or alternative logical expressions (“any”, “every”, etc.) with expressions of a standard type (such as “all”, or the universal quantifier).

Second, certain parts of the sentence must be replaced with schematic letters. Thus, for example, the expression “all As are Bs” shows the logical form common to the sentences “all men are mortals”, “all cats are carnivores”, “all Greeks are philosophers”, and so on.

That the concept of form is fundamental to logic was already recognised in ancient times. Aristotle uses variable letters to represent valid inferences in Prior Analytics, leading Jan Łukasiewicz to say that the introduction of variables was “one of Aristotle’s greatest inventions”. According to the followers of Aristotle (such as Ammonius), only the logical principles stated in schematic terms belong to logic, not those given in concrete terms. The concrete terms “man”, “mortal”, etc., are analogous to the substitution values of the schematic placeholders A, B, C, which were called the “matter” (Greek hyle) of the inference.

The fundamental difference between modern formal logic and traditional, or Aristotelian logic, lies in their differing analysis of the logical form of the sentences they treat.

In the traditional view, the form of the sentence consists of a subject (e.g., “man”) plus a sign of quantity (“all” or “some” or “no”); the copula, which is of the form “is” or “is not”; a predicate (e.g., “mortal”). Thus: all men are mortal. The logical constants such as “all”, “no” and so on, plus sentential connectives such as “and” and “or” were called syncategorematic terms (from the Greek kategorei -- to predicate, and syn -- together with). This is a fixed scheme, where each judgment has an identified quantity and copula, determining the logical form of the sentence.

According to the modern view, the fundamental form of a simple sentence is given by a recursive schema, involving logical connectives, such as a quantifier with its bound variable, which are joined by juxtaposition to other sentences, which in turn may have logical structure.

The modern view is more complex, since a single judgement of Aristotle’s system involves two or more logical connectives. For example, the sentence “All men are mortal” involves, in term logic, two non--logical terms “is a man” (here M) and “is mortal” (here D): the sentence is given by the judgement A(M,D). In predicate logic, the sentence involves the same two non--logical concepts, here analyzed as m(x) and d(x), and the sentence is given by \ forall x. (m(x) \rightarrow d(x)), involving the logical connectives for universal quantification and implication.

But equally, the modern view is more powerful. Medieval logicians recognized the problem of multiple generality, where Aristotelian logic is unable to satisfactorily render such sentences as “Some guys have all the luck”, because both quantities “all” and “some” may be relevant in an inference, but the fixed scheme that Aristotle used allows only one to govern the inference. Just as linguists recognize recursive structure in natural languages, it appears that logic needs recursive structure.

mathematical logics

Mathematical logic really refers to two distinct areas of research: the first is the application of the techniques of formal logic to mathematics and mathematical reasoning, and the second, in the other direction, the application of mathematical techniques to the representation and analysis of formal logic.

The earliest use of mathematics and geometry in relation to logic and philosophy goes back to the ancient Greeks such as Euclid, Plato, and Aristotle. Many other ancient and medieval philosophers applied mathematical ideas and methods to their philosophical claims.

One of the boldest attempts to apply logic to mathematics was undoubtedly the logicism pioneered by philosopher--logicians such as Gottlob Frege and Bertrand Russell: the idea was that mathematical theories were logical tautologies, and the programme was to show this by means to a reduction of mathematics to logic. The various attempts to carry this out met with a series of failures, from the crippling of Frege's project in his Grundgesetze by Russell's paradox, to the defeat of Hilbert's program by Gödel's incompleteness theorems.

Both the statement of Hilbert's program and its refutation by Gödel depended upontheir work establishing the second area of mathematical logic, the application of mathematics to logic in the form of proof theory. Despite the negative nature of the incompleteness theorems, Gödel's completeness theorem, a result in model theory and another application of mathematics to logic, can be understood as showing how close logicism came to being true: every rigorously defined mathematical theory can be exactly captured by a first--order logical theory; Frege's proof calculus is enough to describe the whole of mathematics, though not equivalent to it.

If proof theory and model theory have been the foundation of mathematical logic, they have been but two of the four pillars of the subject. Set theory originated in the study of the infinite by Georg Cantor, and it has been the source of many of the most challenging and important issues in mathematical logic, from Cantor's theorem, through the status of the Axiom of Choice and the question of the independence of the continuum hypothesis, to the modern debate on large cardinal axioms.

Recursion theory captures the idea of computation in logical and arithmetic terms; its most classical achievements are the undecidability of the Entscheidungsproblem by Alan Turing, and his presentation of the Church--Turing thesis. Today recursion theory is mostly concerned with the more refined problem of complexity classes--when is a problem efficiently solvable?--and the classification of degrees of unsolvability.

philosophical logics

Philosophical logic deals with formal descriptions of ordinary, non--specialist (“natural”) language. Most philosophers assume that the bulk of everyday reasoning can be captured in logic if a method or methods to translate ordinary language into that logic can be found. Philosophical logic is essentially a continuation of the traditional discipline called “logic” before the invention of mathematical logic. Philosophical logic has a much greater concern with the connection between natural language and logic. As a result, philosophical logicians have contributed a great deal to the development of nonstandard logics (e.g. free logics, tense logics) as well as various extensions of classical logic (e.g. modal logics) and non--standard semantics for such logics (e.g. Kripke’s supervaluationism in the semantics of logic). Logic and the philosophy of language are closely related. Philosophy of language has to do with the study of how our language engages and interacts with our thinking.

Logic has an immediate impact on other areas of study. Studying logic and the relationship between logic and ordinary speech can help a person better structure his own arguments and critique the arguments of others. Many popular arguments are filled with errors because so many people are untrained in logic and unaware of how to formulate an argument correctly.

computational logics

Computational logic is the use of logic to perform or reason about computation. It bears a similar relationship to computer science and engineering as mathematical logic bears to mathematics and as philosophical logic bears to philosophy. It is synonymous with “logic in computer science”.

The term “Computational Logic” came to prominence with the founding of the ACM Transactions on Computational Logic. However, its first use was probably in 1972 when the Metamathematics Unit at the University of Edinburgh was renamed “The Department of Computational Logic” in the School of Artificial Intelligence. The term was then used by Robert S. Boyer and J Strother Moore, who worked in the Department in the early 1970s, to describe their work on program verification and automated reasoning. They also founded a company Computational Logic Inc. of the same name.

The term “Computational Logic” has also come to be associated with logic programming, because much of the early work in logic programming in the early 1970s also took place in the Department of Computational Logic in Edinburgh. It was reused in the early 1990s to describe work on extensions of logic programming in the EU Basic Research Project “Compulog” and in the associated Network of Excellence. Krzysztof Apt, who was the co--ordinator of the Basic Research Project Compulog--II, reused and generalized the term when he founded the ACM Transactions on Computational Logic in 2000 and became its first Editor--in--Chief.

Logic cut to the heart of computer science as it emerged as a discipline: Alan Turing’s work on the Entscheidungsproblem followed from Kurt Gödel’s work on the incompleteness theorems. The notion of the general purpose computer that came from this work was of fundamental importance to the designers of the computer machinery in the 1940s.

In the 1950s and 1960s, researchers predicted that when human knowledge could be expressed using logic with mathematical notation, it would be possible to create a machine that reasons, or artificial intelligence. This was more difficult than expected because of the complexity of human reasoning. In logic programming, a program consists of a set of axioms and rules. Logic programming systems such as Prolog compute the consequences of the axioms and rules in order to answer a query.

art and design

fashion
and textile design

Fashion designers routinely make use of geometrical implements such as T--squares and rulers, with straight lines being a common sight in contemporary fashion. These include crisp, straight--edged collars and A--line dresses that flare out from the body. Particularly in prints, checkers, bold zigzags and grids are common. Some designers aim for a disguising of the natural figure with such geometry, often by combining straight--edged garments with grid--like patterning.

Geometrical principles underpin fashion design more generally. For example, garments must be balanced on the body around a central fulcrum. This can be achieved through the use of symmetry or, with greater difficulty (and therefore greater expense), by exploring asymmetrical pattern designs.

Of course, fashion designers also keep in mind the way in which garments will fit on the body and which parts of the body will be drawn attention to while wearing the garment. This is accomplished with a keen knowledge of angles, and the way in which lines come together to create a garment’s focal point.

It is not surprising that the various regions developed their own systems of textile measurement and textile vocabulary. In a world in which the pace of life was relatively slow, regional variations in systems of units were tolerable, but to--day communications are rapid, and commerce and technology need a uniform system of measurement that is universally accepted and understood. Errors of conversion are automatically eliminated, but, of course, during the transitional stage, there will be misunderstandings and arithmetical errors when old units are converted into new, even when prepared conversion tables are used. For textile calculations, it may be found that the usual sets of conversion tables do not include quantities peculiar to the textile industry. For these quantities, a conversion system has to be devised by using first principles and then published as a table or graph or left just as a conversion factor.

Most of the calculations made by a textile technologist consist of a series of relatively simple steps, mainly arithmetical and at times using elementary aspects of trigonometry, geometry Algebra. The calculation is generally straightforward; it is the local thinking required that often presents most difficulty. It is usually worth spending a few minutes in considering various approaches to a problem before setting down the first line of calculation. An engineer or research scientist may employ more complex mathematics, a thorough training in pure and applied mathematics being required.

The objective of any experiment or measurement should be to produce an answer that is as accurate as the instruments available and the skill of operator will allow. For many calculations, the person doing the necessary numerical work has a rough idea of the order of magnitude he should obtain. Scientific sampling, design of experiments, the analysis, presentation and interpretation of data through statistical techniques--all these created the concept of specification, production and inspection as a dynamic cycle. Inspection now is the source of data which, analyzed and interpreted through statistical methods, is continuously feed back to production people for corrective and preventive action. Inspection, that is, the act of screening out defectives before they reached the customer.

need for mathematics and textiles

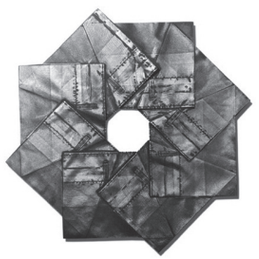
In any manufactured product no two articles are perfectly alike, For example, it is impossible to find two knots of yarn having exactly the same count, strength, evenness, length etc. this is because the raw material i.e. cotton itself varies from fibre to fibre within a bale, bale to bale, and season to season. The quality of the product in each process, therefore, varies according to the variation in the raw material used and degree of technical and refinement attained during processing. Further, machines and tools wear and tear due to long use it is neither possible nor economical to replace the machine. Superimposed on this is the variation arising from lack of fibre control during drafting and that from chance causes. Further, it is impossible to eliminate the effect of human factor entirely. Changes in atmospheric conditions also contribute towards an increase in overall variation in the quality of the product. These variations in various regions are often occurring problems in textile. Using various mathematical calculations can solve these variations.

Born from a union between mathematics and clothes making . In the autumn of 2010, ISSEY MIYAKE's Reality Lab. will present "132 5. ISSEY MIYAKE". Reality Lab. is a research and development team lead by Issey Miyake and two staff members, Manabu Kikuchi (textile engineer) and Sachiko Yamamoto (pattern engineer) and comprised of a group of designers, some of whom are young and relatively new to the Miyake Design Studio. Born from a union between mathematics and clothes making.

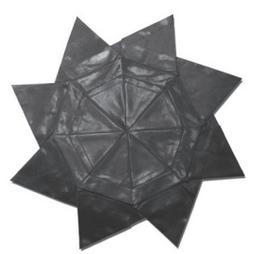
The team was formed in 2007, and currently has 8 members. The Reality Lab. is a project based upon the principal of collaboration and teamwork . Their goal is, through research, to explore the future of making things from clothing to industrial products. The Reality Lab. always seeks to create products that reflect what people need and to find new ways to stimulate creative production in Japan.

Japan has always created beautiful and beautifully--made things by striking a balance in work that lies between the aesthetic and the practical. Today, however is a very different era. One example of this is the current situation that surrounds the manufactures. Unfortunately, cost--cutting often becomes a factory's primary motivating factor. As a result, talented workers, the very backbone of the local manufacturing strength, are lost. How to pass on and educate the valuable technical skills remain as the major problem to be solved. We need to be aware that we are at a crossroads in human history, where our natural and human resources are at risk. Our goals must be to find new environmentally--friendly ways by which to continue the art of creation, to utilize our valuable human skills and to make things that will bring joy.

Issey Miyake has always made a point of visiting local material production areas & factories spread all over the country, and developing close working relationships with those working at each site. The exhibition which opened at 21_21 DESIGN SIGHT in 2008 was entitled " XXIst Century Man" and was born from Miyake's (who also curated the exhibition) experiences (and incorporating research by the Reality Lab.). It examined our way of life and the current global environmental crisis with an eye toward new means by which to make things. In 2010, we will present a new project: "132 5. ISSEY MIYAKE", based upon one of the latest developments from the Reality Lab. team's ongoing research. "132 5. ISSEY MIYAKE" continues the exploration into the process of creation and production and offers a new process being developed at the Miyake Design Studio.



The Reality Lab's team first met computer scientist Jun Mitani (Associate Professor at the Graduate School of System and Information Engineering, University of Tsukuba) who is specialized in form modeling in computer graphics and were introduced to his unique geometric shapes in 2008. Inspired by CG application* developed by Dr. Mitani that creates three--dimensional paper model with smoothly curved surface out of a single flat sheet of paper, the team embarked upon a new adventure in research.



A conversation with computer scientist Jun Mitani, a researcher of mathematical methods by which to create three--dimensional structures through the folding of flat paper.

* It is the CG software to create geometric shapes that contain three--dimensional forms with symmetrical axis. Its characteristics are to create the shapes by folding a sheet of paper. Dr. Mitani conducts mathematical research on the creation of three--dimensional forms by folding a flat material.

buddhist idea in fashion design

THE CHINA ART MUSEUM IN SHANGHAI PRESENTED FASHION DESIGNER MANDALI MENDRILLA'S SCULPTURE DRESS ART INSTALLATION

On the sixth of November at the China Art Museum in Shangai, Mandali Mendrilla, an award winning American fashion designer and artist whose work has been featured by Vogue, Tatler, Harper's Bazaar, and MTV, will personally unveil her interactive sculpture dress called 'Mandala of Desires' (Blue Lotus Wish Tree).

The 'Mandala of Desires' will be the centre piece of 428 art pieces in the collection called 'Forms of Devotion' belonging to the Belgian MOSA museum. The collection will be on exhibit from 6th November 2015 till February 21st 2016, as part of the program called `Celebrating India In Shanghai',within the China Shanghai International Arts Festival organised by the Chinese Ministry of Culture and the Indian Embassy in China.

The sculpture dress 'Mandala of Desires' was made in 2015, in 'peace' silk,which is a vegan silk made without killing silk worms. The dress is hand embroidered and handprinted with eco friendly textile ink. The full installation is 1,2 meters tall and 2.5 meters wide.

Mandala of Desires is an interactive art piece creating beautiful life by visualisation. The installation inspires visitors to imagine a beautiful world, write their vision down on a piece of paper or cloth, and hang it on the dress as they would on a branch of a live wish tree. That meditative practice of collective wishing is well known to traditions of the East and has been recently celebrated by Yoko Ono.

The dress pattern was constructed according to a traditional Indian mandala diagram called Goloka Yantra and the thousand petalled lotus (sahasra patra kamalam) described in the ancient Indian hymn, Sri Brahma Samhita, painted on the dress in Devanagari script. Mandala diagrams and the thousand petalled lotus are elements of both Indian and Chinese culture.

The thousand petalled lotus petticoat construction was inspired by the work of Dutch sculptor Bert Van Loo, known for his layered glass sculptures displayed in the city of Amsterdam and galleries worldwide.

“I am looking forward to the exhibition and to visiting Shanghai. I hope the Mandala of Desires will add to the promotion of the culture of positive thinking and the international artistic exchange,” said Mandali today in Brussels.

mathematics meet fashion: thurston’s concepts inspire designer

An ABC News report, “Fashion and Advanced Mathematics Meet at Miyake: Fashion and advanced mathematics collide at Japanese label Issey Miyake,” (2010) generated a lot of interest in the mathematics and fashion communities. Drawings by William Thurston (a pioneer in the field of low--dimensional topology, 1982 Fields Medal winner, and professor of mathematics and computer science at Cornell University) inspired designer Dai Fujiwara (Issey Miyake, Inc.).

Thurston’s brief essay below on mathematics and creativity and his connection with designer Fujiwara was available at the fashion show:

“Beauty is truth, truth beauty,----that is all Ye know on earth, and all ye need to know.”

This famous and provocative quotation of John Keats is echoed on the emblem of the Institute for Advanced Study, where I took my first job after graduate school.

Last summer, after reading an account of my mathematical discoveries concerning eight geometries that shape all 3--dimensional topology, Dai Fujiwara made the leap to write to me, saying he felt in his bones that my insights could give inspiration to his design team at Issey Miyake. He observed that we are both trying to understand the best 3--dimensional forms of 2--dimensional surfaces, and he noted that we each, independently, had come around to asking our students to peel oranges to explore these relationships. This resonated strongly with me, for I have long been fascinated (from a distance) by the art of clothing design and its connections to mathematics.

Many people think of mathematics as austere and self--contained. To the contrary, mathematics is a very rich and very human subject, an art that enables us to see and understand deep interconnections in the world. The best mathematics uses the whole mind, embraces human sensibility, and is not at all limited to the small portion of our brains that calculates and manipulates with symbols. Through pursuing beauty we find truth, and where we find truth, we discover incredible beauty.

graphic design and typography

The repetition of simple geometric shapes forms a daily part of our environment. Throughout the 20th century -- and into the 21st -- typefaces whose designs have taken advantage of this have remained popular. But finding exactly the right mood can be tricky. For your convenience, we have grouped some of our favorite geometric typefaces (mostly sans serif and symbol) into four categories: circles, squares, ovals, and triangles.

ITC Avant Garde Gothic Avenir Next

Century Gothic ITC Bauhaus

CIRCLE TYPEFACES

Circle typefaces are reminiscent of European design from the 1920s, like Herbert Bayer's letterforms from the Bauhaus. But they have never diminished in popularity; just look at ITC Avant Garde Gothic™, from the early 1970s, or Avenir™, from the late 1980s. Typefaces in this category often have their elements boiled down to two simple forms: circles or other rounded forms, and straight lines. Quite a contrast. Use them to represent sleek movement, dynamism, or the future.

LINOTYPE KILLER

Bourgeois

SQUARE TYPEFACES

Square typefaces are stately. Forms like those seen in Morris Sans™ may often be found on official monuments or on sci--fi movie posters. Other square types look more like the techno--era Linotype Killer™. These faces are perfect for the party scene or the computer screen.

COPPERPLATE GOTHIC

ITC FLATIRON

OVAL TYPEFACES

Oval typefaces tend to have more extreme proportions. Either their letterforms are very narrow or very wide, like an oval standing tall or laying on its side. These two extremes can be seen in Seebad™, which is coolly condensed, and Vienna Extended™, whose name says almost all you need to know.

BLACK BOTON

SINALOA

TRIANGLE TYPEFACES

Triangle typefaces are the rarest of the geometric breed. Since triangular forms do not appear often in our alphabet, these faces are purely decorative. Nevertheless, they convey geometry pure!

literature review;

Quantum

quantum and abhidhamma

An atom considered to be the smallest unit of matter which is an aggregate of a number of unitary material elements called as a “Cluster of material elements” or “RUPA--KALAPA”, where every cluster is delimited by an intervening space, so that they do not touch each other. However, according to the Sarastivada tradition, an atom is considered to be the smallest unit of a single unitary material element and it is so minute that it actually lacks spatial dimension. This buddhist concept of matter is very close to Einstein’s concept of quantum, as smallest unit of energy in the universe and also the modern theory of quarks which are hypothesised as mere geometrical points in space that make up the protons and neutrons of an atom. Though the study of the physical world was not the central focus of the traditional areas of learning and specialisation in buddhism, but the buddhist scholars and contemplative and developed views on matters related to the universe and its contents. These views were developed on pure logical and rational thinking and no rigorous methodology was applied for experimenting with the physical world.

Modern physics bears the impact of Albert Einstein more than that of any other physicist. His theory of relativity with its profound modification of the notion of space, time and gravitation had fundamentally changed and deepened our understanding of the physical and philosophical conception of the universe. Thought the study of the physical world was not the central focus of the traditional areas of learning and BARUA Quantum and the Abhihamme 64 specialization in Buddhism, but there are some striking similarities present between Buddhist and modern scientific views related to the concepts of time and space. The Buddhist scholars and contemplatives had developed view on matters related to the universe and its contents which was based on pure logical and rational thinking and no rigorous methodology was applied for study the physical world. These phenomena were discussed in detail in the early Buddhism, the Abhidhamma Pitaka, the Visuddhimagga, the pali commentaries, Mahāvibhāṣāśāstra, the Kālacackra Tantra and in the literature on Buddhist epistemology.

Albert Einstein had published some remarkable scientific papers addressing fundamental problems about the nature of energy, matter, motion, time and space. Some of his theories which could be viewed in light of the Abhidhamma concept of matter are as follows:

•In March 1905, Einstein created the quantum theory of light. This theory dealt with the idea that light exists as tiny packets or particles, which he called photons, Einstein proposed that we live in a quantum universe, one built out of tiny discrete chunks of energy and matter.

•During April and May 1905, Einstein published two new research papers. In one he invented a new method of counting and determining the size of the atoms or molecules in a given space and in the other he explains the phenomenon of Brownian motion. The net result was a proof that atoms actually exist. This brought an end to a millenia--old debate on the fundamental nature of the chemical elements.

quantum and concept of matter in abhidhamma

The Abhidhamma analysis of matter assumes significance within framework of the Dhamma Theory. There are in all 28 rupa--dhammas or material elements which imply that 28 items into which material existence can be analysed. 65 material elements represent not only the matter that enters into the composition of living beings (organic matter) but also the matter that exists in the external world (inorganic matter).

However, matter is defined as that which has the characteristic of “ruppana” which means the susceptibility to being modified or receptivity to change due to the impact of the contrary forces. this is also defined as “Yosaduppatii” or the “genesis of dissimilarity” or change. What is meant by change due to the impact of the disappearance of one material element and the appearance of another material element in its place. So the concept of change is not mer alteration between two stages of a single material element.

The four primary element of matter recognized in buddhism are
(a) earth element -- represents solidity and extension,
(b) Water element -- represents viscidity and liquidity
(c) Fire element -- represents the temperature of cold and heat
(d) Air element -- represents distension, fluctuation and mobility.

These four primary elements are necessarily co--nascent and inseparable. These element arise together, exist together and cease together and they cannot be separated from one another. Though there is no quantitative difference among these elements that enter into composition of material things, but the only difference is the intensity.

As defined in Theravada Abhihamma, the earth--element (pathavi--dhatu) has the characteristics of solidity and extension, which means the three dimensional spatial occupation. Our notion of a solidity body is obtained when matter occupies the three dimension of space. The earth--element which represent solidity and spatial extension is said to be present in every instance of matter.

So every instance of matter is characterised by solidity (whatever be the degree) and extension (whatever be the extent).

The Visuddhimagga states that in this body the earth--element (Pathevi--Dhatu) has the water element (apo--dhatu) measuring half as much. According to the Sarvastivada tradition, and atom is considered to be the smallest unit of a single unitary material element and it is so minute that it actually lacks spatial dimension. The concept is very close to Einstein’s concept of quantum as smallest not of energy in the universe and also the modern theory of “quarks” which are hypothesised as mere geometrical points in space that make up the protons and neutron an atom.When any component of the body is reduced to the size of atoms, each atom in turn should consist of the same four inseparable primary elements.

Thus, the concept of atoms (paramanu) logically points to be an aggregate of primary elements. This is identical with “Kalapa”, but in technical sense it means the smallest cluster of material elements. So, according to the Theravada Abhidhamma tradtion, an atom is an aggregate of a number of unitary material elements and is described not only as an atom (paramunu) but also as a “cluster of material elements” called “Rupa--Kalapa”. Here every “Rupa--Kalapa” is delimited by an intervening space, so that they do not touch each other. However, the attractive force of the air--element keeps the atoms together from escaping. From the point of view of modern science , This indicates the possibility of existence of some kind of an electro magnetic force present between these elements which hold them in cluster without touching each other. Though Einstein had earlier experimentally demonstrated the existence of atoms as smallest particles of matter, but later the was proved that atoms could be further divisible into its charged components of protons, electrons and neutrons which are separated from each other due to their respective electrical charges. Thus the concept of atom perceived as “smallest cluster of material elements” in Theravada Abhidhamma, also point to the concept of further divisibility of atoms. The modern theory of “quarks” which are hypothesise as mere geometrical point in space that make up the protons and neutrons of an atoms also exist as cluster to give definite shape to these structures.

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quantum theory and the buddhist concept of dynamic flux

Abihdhamma considered events as space--time representations of a continuous dynamic flux. Nothing is considered to be static and permanent but everything is in a state of constant change in our universe of experience. However, there is no single enduring changing entity, but they exist a series of momentary changes as “Tathagata” which means “one who comes and goes thus”. The buddha gave this famous doctrine of momentariness (Ksanikavada) in terms of “here and now”. The quantum theory also considers physical phenomena as transient manifestations of an underlying fundamental unity. Following this concept of dynamic flux. Einstein had also demonstrated the spontaneous and random movement of atoms, called Brownian motion.

The idea which could be drawn out from his observations is that there is nothing in a constant static state in this universe. All is particles in this universe are in dynamic motion with relation to each other and their tendency to execute the random movement are restricted due to the strong gravitational and electromagnetic forces of each other. The doctrine of the Buddha related to the dependent origination also supports this concept by considering everything in the universe that we are able to perceive though our sense organs are impermanent and are subjected to constant change from moment to moment. This is the buddhist counter part of the phenomenon of dynamic flux.

einstein’s notion of escape velocity and black holes.

Einstein proved the theory of escape velocity which is use in all astronomical studies of modern times. When any space shuttle is launched from the earth’s surface. It must have an initial speed of at least 11 km/s (25,000 miles/hr). If the shuttle’s launched speed exceeds this speed. It can escape earth’s gravitational field and make it into space. If the launch speed is less than this escape velocity. It will back to earth. The BURUA Quantum and the Abhidhamma value of the escape velocity from planet or star depends on its mass and radius. The escape velocity is directly proportional to mass but inversely proportional to the radius and volume of a substance. If a star is compressed to a smaller size without changing its mass, its escape velocity will increase, This is due to the fact that a greater speed is needed to escape the greater gravitational force on its surface as it is more densely compressed to a smaller size without changing its mass, tis escape velocity will increase. This is due the fact that a greater speed is needed to escape the greater gravitational force on its surface as it is more densely compressed.

In the Theravada Abhidhamma tradition, an atom is considered to be an aggregate of a number of unitary material elements called as a “cluster of material elements” or “RUPA--KALAPA”.

Here, every “RUPA--KALAPA” is delimited by an intervening space, so that they do not touch each other. However, the attractive force of air--element keeps the atoms together from escaping from. From the point of view of modern science, this indicates the possibility of existence of some kind of an electromagnetic force present between these elements which hold them in cluster without touching each other.

This Abihidhamma perception of non--collapsing cluster of material elements with the attractive force of air--element holding them in position could define Einstein’s concept of escape velocity of a non--collapsing celestial mass. According to Einstein’s special theory of relativity, the speed of light is the ultimate speed limit in the universe. Nothing can travel faster than light. Hence, when a star collapses to the point that its escape, not even light. A black hole is simply a star that has collapse so much that its escape velocity is greater than the speed of light. Travelling into a blackhole is thus the ultimate one way trip. There is no travelling back from it.

This happens when the mose massive star at the end of their lives explode as supernova. If the central core of the star left after the explosion is at least about 2 to 3 times as massive as the sun. There is no force known to modern science that can resist the inward tug of gravity. It will continue to compress until it collapses into a blackhole. Because no known force can stop the collapse, all the matter in what was once the star is compressed into a geometric point. It has a radius of zero. This point is called the singularity. The singularity has the same mass as the core of the star that collapsed into the back hold compressed into a radios and volume of zero. Hence it has an infinite density.

The distance from the singularity to where the escape velocity equals the speed of light is called the Schwarzschild radius or event horizon. The Schwarzschild radius of a black hole ten times as massive as the sun is 30 kilometers. Schwarzschild predicted this effect from Einstein's general theory of relativity. Although nothing can escape from inside the event horizon. Blackholes don't automatically slurp up everything nearby. It is possible to orbit a black hole without falling in.

In the sarcastivada Abhidhamma tradition, An atoms is considered to be the smallest unit of a single unitary material element and it is so minute that it actually lacks spatial dimension. So the Sarvastivadins believe that an atom is devoid of parts and exempt from resistance or impenetrability. Keeping this concept in background, if we presume that atoms touch each other totally and without any intervening space in between. Then they would all collapse into one and all would occupy the same locus. This Abhidhamma concept of complete collapse of elementary particles of matter relates to the theory of origination of dimensionless dark holes with enormous celestial mass.

The concept of "emptiness" in Madhyamika tradition by Nagariuna also suggest that except the "Nibbana" and "Space". Whatever we perceive through our sense organs is virtual. Thought the dark holes have enormous celestial mass and gravitational force of attraction but they could be regarded as dimensionless virtual mass. In spite of having real existence, They remain invisible to the human eye as they absorb all the light rays that fall on them and reflect none. We see only about 10% of the total mass of the clusters in the form of the individual galaxies in the clusters. The remaining 90% is dark matter. Since the dark matter has immense mass and gravitational pull to trap all the light rays that fall on them and never reflect anything. They remain invisible to the human eye.

So we might not be able to locate 90% of matter in the universe which are in the form of dark matter.

einstein's view on energy for expanding universe

Einstein thought earlier that the space was not expanding and he used in his calculations a factor named "Cosmological Constant" to cancel the expansion effect. But later he changed his mind and supported the theory that expansion of the universe really happening. He had proved this theory by demonstrating the shift of light towards the red spectrum to confirm this expansion of the universe. The universe is considered to have a constant amount of energy since the beginning and as mass is a concentrated from of energy. What really happen is the change of energy from one type to another. To explain the expansion of the universe, there is the theory spontaneious generation of matter which means mass appears from energy to fill the space so as to contradict the "Big bang" theory. Scienctists do not really know why space is expanding. However, measurements and obsercation are best explained by considering the universe to be expanding. Though they're are a variety of possible explanations put forward by the modern scientists but we do not know for certain if any of these are correct.

Journal for interdisciplinary research on religion and science, Albert Einstein was very much influenced by the buddhist doctrines related to the concepts of absence of any creator God, Absence of any soul or self (Anatta). Dependent Origination (Paticcasamuppada), Impermanence (Anicca) and the emphasis on practicing compassion with moral--driven volitional activities (Kamma). He had also predicted that the religion of the future will be a "cosmic religion". It would transcend personal God and avoid dogma and theology. Covering both the natural and the spiritual, It should be based on a religious sense arising from the experience of all things natural and spiritual as a meaningful unity. In his opinion. Buddhism answer this description. Buddhism has the characteristics of what would be expected in a cosmic religion for the future. It transcends a personal GOD avoid dogmas based on a religious sense aspiring from the experience of all things, natural and spiritual as a meaningful unity. So "if scientific needs, it would be buddhism".

on quantum theory of consciousness and nature of reality

A Quantum Theory of Consciousness May Require a Paradigm Shift in Biology by Maurice Goodman

It is often assumed that the known physical laws form a closed system and are complete. It is also assumed that biological theories require no additional principles that are fundamental other than those we already know. Assumptions such as these are acting as a barrier to progress in biological theories and an understanding of consciousness. This paper examines the unexplained inconsistencies among fundamental particles and forces and the fundamental gaps in our knowledge of biology and the cell in particular that may impact on such progress. Also, the laws of quantum mechanics are examined and found to be grossly incomplete. Furthermore, gravitational decoherence times are way too long and electromagnetic decoherence times are way too short to relate to millisecond brain processes. Surprisingly, weak force decoherence times over cellular distances are of the relevant dynamical timescale needed, suggesting that if any force is associated with the global properties in and between neurons (such as consciousness) it is the weak force. This finding concurs with a twenty year old theory that argues for a fundamental link between the weak force, electron neutrino and the biological cell. That theory also predicted the mass of the electron neutrino that is soon to be verified. The consequences for biology and future consciousness theories, of this radical change of paradigm, are considered.

the universe is composed of that which is aware of the universe

My philosophy is that That of which the universe is actually composed is not other than That which is aware of the universe. We, as formless Awareness, create the experiential forms to which we then cling, thinking that our continued being depends on our continued clinging. But how can our being depend upon something that we ourselves create, something that in the absence of our being, in the absence of our Awareness, cannot even be known?

the nature of reality in a nutshell by james kowall

Reality is characterized by four aspects of reality: (1) forms of information, (2) the flow of energy, (3) perceiving consciousness, and (4) the Source of information, energy and perceiving consciousness. The scientific framework for this characterization is discussed in terms of the holographic principle, non--commutative geometry, an observer--dependent cosmic horizon arising in de Sitter space with a positive cosmological constant, and the one--world--per--observer paradigm.

In this scenario, the observer is present at the central focal point of a cosmic horizon that arises in the observer's frame of reference, acts as a holographic screen, and projects the observer's space--time geometry. A consensual reality shared by many observers is possible if their respective horizons overlap. This scientific framework can only explain the nature of forms of information and the flow of energy. This leaves us with the quandary of how to explain perceiving consciousness and the Source. An argument is made that perceiving consciousness can only be understood as a focal point of consciousness that is differentiated from the Source and arises in relation to a holographic screen, in which case the Source can only be understood in the non--dual sense of an empty space of potentiality or a void of undifferentiated consciousness. This is Part I of the two--part article.

The Revealed Yet Still Hidden Relation between Form & the Formless
by Steven E. Kaufman

Science holds that it is form that gives rise to the Formlessness by which all form is apprehended. Science has never even considered the opposite possibility. What is the opposite possibility? That it is when formless Consciousness reaches a certain level of complexity that physical forms poof into existence. How does that which is formless become complex? By flowing in relation to itself, over and over and over again.

What Is Versus What Should & Should Not Be by Steven E. Kaufman

The actual source of happiness is the absence of conflict with one's self, and that can be had regardless of whether "what is," in this moment, is or is not wanted. However, when one applies the idea "should not be" to that which is not wanted, then the self-conflict that creates suffering arises. The acceptance and allowing of the forms that arise in one's awareness as "what is" is the shovel that allows one to dig one's self out of the hole of self--conflict that is the ultimate source of one's suffering, as opposed to just continuing to dig the hole deeper using the shovel of what should and should not be.

philosophers

a metaphysics of morality: kant and buddhism

Immanuel Kant's deontology seems to present a radically different approach to morality as understood in the Buddhist tradition (generally understood in the Mahāyāna perspective). Kant's metaphysics relies on the application of pure practical reason, whereas Buddhism's appeal is to compassion/karuna; thus the first is cognitive and the second affective, at least on a surface reading. I propose that the two can be brought into direct dialogue via an analysis and pragmatic critique of morality's ideal of universality. First I outline the key components of Kant's categorical imperative, and show that the kingdom of ends is a "natural development" from this moral command. Next I explore the impetus of the Buddha's search for the alleviation of suffering/ duhkha, and explain that the bodhisattva is a "natural development" from the Buddha's insight/prajna. In both instances, the criterion of universality is an intrinsic and necessary feature for morality. Given this conclusion, I will endeavour to provide an affective element for Kant's deontology and a rational aspect for Buddhist compassion, thus bringing both approaches together as a demonstration of emotional rationality. "Act only on that maxim whereby you can at the same time will that it should become a universal law" (acceptable by all rational beings). --Immanuel Kant "The Mahāyāna has a nature of giving, ethics, patience, effort, concentration, wisdom and compassion..." --Nāgarjuna Immanuel Kant's deontology seems to present a radically different approach to morality as compared to Buddhism's Mahāyāna tradition. Kant's metaphysics relies on the application of pure practical reason, whereas Buddhism's appeal is to compassion/ karutā--thus the former is cognitive and the latter affective, at least on a surface reading. I propose that the two can be brought into a direct comparative dialogue via an analysis and pragmatic critique of morality's ideal of universality. First, I outline the key components of Kant's categorical imperative, and show that the kingdom of ends is a "natural development" from this moral command. Next I explore the impetus of the Buddha's search for the alleviation of suffering/ dukkha, and explain that the bodhisattva is a "natural development" from the Buddha's insight/prajña. In both instances, the criterion of universality is an intrinsic and necessary feature for morality. Given this conclusion, I will endeavour to provide an affective element for Kant's deontology and a rational aspect for Buddhist compassion, thus bringing both approaches together as a demonstration of emotional rationality.

kant and the moral law

In his Fundamental Principles of the Metaphysics of Morals, Kant claims that through his analysis of what we generally understand by morality that he can uncover that obligatory foundation upon which all moral principles ultimately depend. This is the moral law of the categorical imperative. The categorical imperative is a completely absolute command and abstract idea; in addition, given its nature, it obligingly calls upon us (qua rational beings or persons) to follow our duty. For Kant then, an action is morally worthy if and only if it accords with and is done for the sake of duty. The force behind our obligatory duty is grounded in the a priori structure of the moral law, meaning that the law is non--empirical, non--contingent, necessary, rational, abstract, obligatory, absolute, and formal. In other words, the moral law is universal--it applies everywhere, all the time, in the same way to everyone/rational being: "...Since moral laws ought to hold good for every rational creature, we must derive them from the general concept of a rational being...we must treat it independently as pure philosophy, i.e. as metaphysic, complete in itself." This "derived" metaphysic provides the ground for the moral law.

Kant claims that the moral worth of an action stems from whether or not the motive/ maxim for such an action is drawn directly from one's duty (rational obligation) or inclination (desire, feeling, emotion, affect, sentiment--which may conform to duty, but not be morally worthy). An action's moral worthiness is not determined by the purpose or end towards which it is directed, but rather it stems from the principle of volition or the maxim of the good will that motivates the acting agent. The implications of these two propositions (of duty) entail that an action's moral worth is directly related to the reason(s) a person follows, and that the consequences of such an act should not be considered in evaluating the act's merit. Now this is not to say that a person who is following the dictates of the Kantian moral law does not aim at producing specific and beneficial outcomes; instead, it is that such results stand beyond the free choice or autonomy of the acting agent and they cannot determine the act's worth. For Kant, only persons who can act in an autonomous or free fashion can comport themselves in morally worthy manners. These elements are at the core of the deontological approach to the moral law.

How is such an all--encompassing universal law generated? And why does such a moral law have any obligatory force? The answers to these questions are bound to Kant's understanding of autonomy. Only rational beings can act in an autonomous fashion, that is, only they can give themselves reasons (principles of volition) to act without being influenced by empirical and/or emotional concerns, such as inclinations and desires, for to do so is to act according to heteronomy. Heteronomy occurs when the person's will is determined by contingent factors that are beyond the person's control; in other words, such actions are not freely chosen. In contradistinction, "An agent acts autonomously to the extent that [she/] he frees [her/]himself from contingent determinations, that is, from mere preferences or from conventional considerations of status and tradition." By acting freely and autonomously, Kant holds that rational beings generate within themselves the prescriptions of duty, that is, the moral law.

According to Jurgen Habermas, Kant characterizes freedom in general as an agent's capacity to subordinate [his/]her will to maxims, that is, to orient [his/]her actions by rules whose concept [he/]she has mastered. Thus freedom of choice [Willkürfreiheit] enables one to adopt rules of prudence or skill depending on one's inclinations and subjectively selected ends, whereas "freewill" [freie Wille] obeys universally valid laws that it has imposed on itself from a moral point of view.

The ends or goals of such impositions are located within themselves, independent of their phenomenal effects and empirical consequences. Hence when each and every rational being gives themselves the moral law, they do so by creating a purely rational principle that is generated by pure practical reason.

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The ends or goals of such impositions are located within themselves, independent of their phenomenal effects and empirical consequences. Hence when each and every rational being gives themselves the moral law, they do so by creating a purely rational principle that is generated by pure practical reason.

To briefly digress, Kant's pure practical reason is one mode of the faculty of reason. Reason has two general functions: the first is epistemological; and the second is moral. In terms of the first, speculative reason aids rational beings in developing empirical knowledge about phenomenal experience, the world of sensory appearances, as well as abstract knowledge about metaphysics. The second mode of reason generates principles that tell rational beings how they ought to act. Thus, by pure practical reason, Kant is referring to that specific rational faculty of the mind; by pure, he means the a priori and abstract concepts with which this faculty constitutes (legislates) its principles; and the term practical is not meant in a pragmatic sense, but rather in the straightforward sense that the rational faculty makes the rational being act. Pure practical reason is then considered to be the good will, for it is good without qualification or any appeal to what it produces, that is, its consequences; it is good within itself. It is through this internality by which we can uncover the universality of Kant's understanding of duty.

Duty is the necessity of acting from respect (or reverence) for the moral law as determined according to the a priori principles of reason. Respect is a feeling that is generated by reason before an action/event takes place--it is not an effect like other sentiments. Generally speaking, our experiences of emotional states follow from various causes--for example, say I strike the random person sitting next to me on the subway. Their reaction will probably be at first surprise, and then anger. The emotions follow from the cause; they are consequential effects. Kant's notion of rational respect functions in a different manner. Let us look at a key footnote from the first section of Kant's small text:

...Although respect is a feeling, it is not a feeling received through influence, but is self--wrought by a rational concept, and, therefore, is specifically distinct from all feelings of the former kind, which may be referred either to inclination or

fear. What I recognize immediately as a law for me, I recognize with respect. This merely signifies the consciousness that my will is subordinate to a law, without the intervention of other influences on my sense. The immediate determination of the will by the law, and the consciousness of this is called respect, so that this is regarded as an effect of the law on the subject, and not as the cause of it...Accordingly it is something which is considered neither as an object of inclination nor of fear, although it has something analogous to both. The object of respect is the law only, and that, the law which we impose on ourselves, and yet recognize as necessary in itself.

This respect for the moral law is the reason/motive that obliges rational beings to create and give the law to themselves. At first glance, this seems a bit circular, but we necessarily give ourselves the law of morality, which we respect for itself, and this is indicative of our autonomy. “Only moral reasons...bind the wills of agents unconditionally, that is, independently of a given individual’s preferences even of the value--orientations of a given community.” The rational being does this because the moral law has an unqualified and universal worth that reason respects in and of itself. Pure practical reason generates what it respects, that is, the moral law, and the moral law evokes respect from its generator, urging its very generation (or legislation-- see the discussion below).

The moral implications for this internally generated moral law are far reaching. Each rational being generates the moral law that obligates dutiful action due to the respect that each has for the law itself. The moral law then is instantiated in each rational being. Thus each rational being is a respectful generator of the moral law, and since the moral law is worthy of unqualified respect, then each instantiation, each rational being, is worthy of such respect because of the law within.

“The capacity to act for reasons all the way down [that is, purely and internally] is defining of rational agency. Kant calls this autonomy. It is what we respect in respecting a person as an end--in--[him/]herself.” Given that the moral law is applicable and valid for every rational being, this rational emotion (qua feeling) of respect is necessarily and universally extendable (to every rational being). The consequences of Kant’s moral law culminate in the extension of his ideals into the kingdom of ends.

The moral law is the categorical imperative (the absolute command of necessary moral obligation): it states, “Act only on that maxim whereby you can at the same time will that it should become a universal law” (acceptable by all rational beings). A will that functions in this manner acts according to rational principles that it gives itself; this is the good will or pure practical reason. The good will commands each person qua rational being to “So act as to treat humanity, whether in your own person or in that of any other, in every case as an end--in--itself, never merely as a means.” Thus, in order to fulfill this duty, persons must be accorded the same respect that one finds within oneself for the moral law; for to do otherwise is to, in essence, disrespect the other’s autonomy, that is, the moral law as it is instantiated in each and every rational being. In other words, the categorical imperative obligates persons to not use others for selfish or egocentric goals these would be heteronomous actions in any case. Every rational being “possesses a dignity (an absolute inner worth) whereby [she or] he exacts the respect of all other rational beings in the world, can measure [her/]himself against each member of [her/] his species, and can esteem [her/]himself on a footing of equality with them.” Such an egalitarian duty points beyond the needs of the individual, bringing them into a rational synchronicity with all other rational beings. This is the will that is in harmony with pure practical reason, which is “the idea of the will of every rational being as a universally legislative will.” When each rational being exercises their good will, such wills will accord with the same universal principles generated by pure practical reason.

The practical implication of this ideal is that, in any given moral situation that calls for a choice or judgment, the acting moral agent legislates a universal law to which all other rational beings are subject; yet their roles may change, for when another moral agent acts in a similar fashion, the first then becomes subject to this other’s legislated moral law. Thereupon, the moral law calls for the establishment of the kingdom of ends: this kingdom is a union of different rational beings in a system of common or universal laws as legislated by pure practical reason. Habermas

describes this as when the ideal of freedom, one of the practical ideas of reason, receives its “concrete expression.” All rational beings fall under this ideal (utopian?) rubric. Each as an instantiation and generator of the moral law is sometime ruler/legislator, and sometime subject/citizen to the principles pronounced by pure practical reason.

In sum, Kant’s metaphysics of morals relies, at its core, on the self--wrought rational emotion of respect. This affect, generated within, applies to every instantiation of the moral law found in each rational being. The full expression of this ideal culminates in the consciously and autonomously chosen recognition of the duties that each person ought to follow with respect to all other persons (and themselves). As Lara Denis claims in her recent introduction to Kant’s Groundwork, “What matters morally is whether the maxim of the action is one that shows proper respect for rational nature. The notion that morality has essentially to do with respect for persons and their capacity to make choices for themselves is one of the most influential and compelling ideas in Kant’s ethics.” In accordance with reason, then, all rational beings necessarily in the greater ideal of the kingdom of ends that binds each and every individual to all others. However, we must acknowledge that human beings often fall short of such obligations, for very few can consistently hold to such demanding universal ideals. It is precisely in the Mah y na tradition of the bodhisattva that we find descriptions of moral exemplars who nonetheless attempt to do just this. While their motivations emphasize a different affect, they nonetheless aim to apply Buddhist doctrinal ideals in a universal fashion that parallels Kant’s vision.

One might be moved to claim that Buddhist ethics employs notions like moral exemplars and virtues, and that these fall within a different kind of philosophical category from the deontology of Kantian moral philosophy. While this is prima facie a valid claim, by no means is it clear that Buddhist ethics is limited to the Aristotelian category of a character based ethics, nor does Kant’s approach rule out the moral worth of the virtues. In terms of the former, the ethical prescriptions of the Eight--Fold Noble Path certainly bear the marks of rules, that is, moral laws, as do the vows taken by monks and bodhisattvas; and with the cultivation of right mindfulness and concentration, the role of “correct” motivations is an important and intrinsic element to karma formation. As for Kant, the development of virtues (subjective talents) can be conducive to fulfilling the demands and obligations of the moral law. Thus we ought not to let this distinction (character vs. act) prevent the attempt here to contribute to the literature on comparative ethics. Let us then proceed with bodhisattva compassion.

the connection in terms of principle between western philosopher and buddhism

Buddhist thought and Western philosophy include several interesting parallels. Before the 20th century, a few European thinkers such as Arthur Schopenhauer had engaged with Buddhist thought. After the post--war spread of Buddhism to the West there has been considerable interest by some scholars in a comparative, cross--cultural approach between eastern and western philosophy. Much of this work is now published in academic journals such as Philosophy East and West.

Hellenistic philosophy

According to Edward Conze, Greek Skepticism (particularly that of Pyrrho) can be compared to Buddhist philosophy, especially the Indian Madhyamika school. The Pyrrhonian Skeptics had a soteriological goal which they called Ataraxia (peace of mind). They promoted withholding judgment (Epoché) about facts of the world as a way to reach that goal. This is similar to the Buddha's refusal to answer certain metaphysical questions which he saw as non--conductive to the path of Buddhist practice and Nagarjuna's "relinquishing of all views (drsti)". Adrian Kuzminski argues for direct influence between these two systems of thought. In Pyrrhonism: How the Ancient Greeks Reinvented Buddhism, Kuzminski writes: "its origin can plausibly be traced to the contacts between Pyrrho and the sages he encountered in India, where he traveled with Alexander the Great." According to Kuzminski, both philosophies argue against assenting to any dogmatic assertions about an ultimate metaphysical reality behind our sense impressions as a tactic to reach tranquility and both also make use of logical arguments against other philosophies in order to expose their contradictions. Buddhist thought can also be compared to Classical Cynicism and Stoicism, in that all of these world views sought to develop a set of practices to reach a state of equanimity by the removal of desires and passions.

Hume and Not--Self
The Scottish philosopher David Hume wrote:

"When I enter most intimately into what I call myself, I always stumble on some particular perception or other, of heat or cold, light or shade, love or hatred, pain or pleasure. I never catch myself at any time without a perception, and never can observe any thing but the perception"

According to Hume then there is nothing that is constantly stable which we could identify as the self, only a flow of differing experiences. Our view that there is something substantive which binds all of these experiences together is for Hume merely imaginary. The self is a fiction that is attributed to the entire flow of experiences.

Pain and pleasure, grief and joy, passions and sensations succeed each other, and never all exist at the same time. It cannot, therefore, be from any of these impressions, or from any other, that the idea of self is derivid; and consequently there is no such idea...I may venture to affirm of the rest of mankind, that they are nothing but a bundle or collection of different perceptions, which succeed each other with an inconceivable rapidity, and are in a perpetual flux and movement.

This 'Bundle theory' of personal identity is very similar to the Buddhist notion of not--self, which holds that the unitary self is a fiction and that nothing exists but a collection of five aggregates.Similarly, both Hume and Buddhist philosophy hold that it is perfectly acceptable to speak of personal identity in a mundane and conventional way, while believing that there are ultimately no such things. Hume scholar Alison Gopnik has even argued that Hume could have had contact with Buddhist philosophy during his stay in France (which coincided with his writing of the Treatise of Human Nature) through the well traveled Jesuit missionaries of the Royal College of La Flèche.

British philosopher Derek Parfit has argued for a reductionist and deflationary theory of personal identity in his book Reasons and Persons. According to Parfit, apart from a causally connected stream of mental and physical events, there are no “separately existing entities, distinct from our brains and bodies”. Parfit concludes that “Buddha would have agreed.” Parfit also argues that this view is liberating and leads to increased empathy.

Is the truth depressing? Some may find it so. But I find it liberating, and consoling. When I believed that my existence was such a further fact, I seemed imprisoned in myself. My life seemed like a glass tunnel, through which I was moving faster every year, and at the end of which there was darkness. When I changed my view, the walls of my glass tunnel disappeared. I now live in the open air. There is still a difference between my lives and the lives of other people. But the difference is less. Other people are closer. I am less concerned about the rest of my own life, and more concerned about the lives of others.

According to the New Yorker’s Larissa MacFarquar, Reasons and Persons has been studied and chanted at a Tibetan Buddhist monastery.

Other Western philosophers that have attacked the view of a fixed self include Daniel Dennett (in his paper The Self as a Center of Narrative Gravity) and Thomas Metzinger (The Ego Tunnel).

IDEALISM

Idealism is the group of philosophies which assert that reality, or reality as we can know it, is fundamentally mental, mentally constructed, or otherwise immaterial. Some Buddhist philosophical views have been interpreted as having Idealistic tendencies, mainly the cittamatra (mind--only) philosophy of Yogacara Buddhism as outlined in the works of Vasubandhu and Xuanzang. Metaphysical Idealism has been the orthodox position of the Chinese Yogacara school or F xiàng--zōng. According to Buddhist philosopher Vasubhandu “The transformation of consciousness is imagination. What is imagined by it does not exist. Therefore everything is representation--only.” This has been compared to the Idealist philosophies of Bishop Berkeley and Immanuel Kant. Kant’s categories have also been compared to the Yogacara concept of karmic vasanas (perfumings) which condition our mental reality.

PANPSYCHISM

Panpsychism is the view that mind or soul is a universal feature of all things, this has been a common view in western philosophy going back to the Presocratics and Plato. According to D. S. Clarke, panpsychist and panexperientialist aspects can be found in the Huayan and Tiantai (Jpn. Tendai) Buddhist doctrines of Buddha nature, which was often attributed to inanimate objects such as lotus flowers and mountains.

buddhism and german philosophy

Immanuel Kant's Transcendental Idealism has also been compared with the Indian philosophical approach of the Madhyamaka school by scholars such as T. R. V. Murti. Both posit that the world of experience is in one sense a mere fabrication of our senses and mental faculties. For Kant and the Madhyamikas, we do not have access to 'things in themselves' because they are always filtered by our mind's 'interpretative framework'. Thus both worldviews posit that there is an ultimate reality and that Reason is unable to reach it. Buddhologists like Edward Conze have also seen similarities between Kant's antinomies and the unanswerable questions of the Buddha in that "they are both concerned with whether the world is finite or infinite, etc., and in that they are both left undecided."

Arthur Schopenhauer was influenced by Indian religious texts and later claimed that Buddhism was the "best of all possible religions."Schopenhauer's view that "suffering is the direct and immediate object of life" and that this is driven by an "restless willing and striving" are similar to the four noble truths of the Buddha.Schopenhauer promoted the saintly ascetic life of the Indian sramanas as a way to renounce the Will. His view that a single world--essence (The Will) comes to manifest itself as a multiplicity of individual things (principium individuationis) has been compared to the Buddhist trikaya doctrine as developed in Yogacara Buddhism. Finally, Schopenhauer's ethics which are based on universal compassion for the suffering of others can be compared to the Buddhist ethics of Karuṇā.

Friedrich Nietzsche admired Buddhism, writing that it "...already has...the selfdeception of moral concepts behind it ---- it stands, in my language, Beyond Good and Evil." However he still believed that Buddhism was a form of oriental life denying nihilism.

According to Reinhard May and Graham Parkes, Heidegger may have been influenced by Zen and Daoist texts. Some of Martin Heidegger's philosophical terms, such as Ab--grund (void), Das Nichts (the Nothing) and Dasein have been considered in light of Buddhist terms which express similar ideas such as Emptiness.

Heidegger wrote that: "As void [Ab--grund], Being 'is' at once the nothing [das Nichts] as well as the ground. "Heidegger's "Dialogue on Language", has a Japanese friend (Tezuka Tomio) state that "to us [Japanese] emptiness is the loftiest name for what you mean to say with the word 'Being'" Heidegger's critique of metaphysics has also been compared to Zen's radical anti--metaphysical attitude. William Barrett held that Heidegger's philosophy was similar to Zen Buddhism and that Heidegger himself had confirmed this after reading the works of DT Suzuki.

phenomenology and existentialism

Some scholars reject the idealist interpretation of Vasubhandu's Yogacara and instead interpret him through the lens of Western Phenomenology which is the study of conscious processes from the subjective point of view. The German Buddhist monk Nyanaponika Thera wrote that the Buddhist Abhidhamma philosophy "doubtlessly belongs" to Phenomenology and that the Buddhist term dhamma could be rendered as "phenomena".

Jean--Paul Sartre believed that consciousness lacks an essence or any fixed characteristics and that insight into this caused a strong sense of Existential angst or Nausea. Sartre saw consciousness as defined by its ability of negation, this happens because whenever consciousness becomes conscious of something it is aware of itself not being that intentional object. Consciousness is nothingness because all being--initself -- the entire world of objects -- is outside of it. Furthermore, for Sartre, being--in--itself is also nothing more than appearance, it has no essence. This conception of the self as nothingness and of reality as lacking any inherent essence has been compared to the Buddhist concept of Emptiness and Not--self. Just like the Buddhists rejected the Hindu concept of Atman, Sartre rejected Husserl's concept of the transcendental ego.

Merleau--Ponty's phenomenology has been said to be similar to Zen Buddhism and Madhyamaka in that they all hold to the interconnection of the self, body and the world (the "lifeworld"). The unity of body and mind (sh nx n) expressed by the Buddhism of Dogen and Zhanran and Merleau--Ponty's view of the corporeity of consciousness seem to be in agreement. They both hold that the conscious mind is inherently connected to the body and the external world and that the lifeworld is experienced dynamically through the body, denying any independent Cartesian Cogito.

buddhism and process philosophy

The process philosophy of Alfred North Whitehead has several convergent points with Buddhist philosophy. Whitehead saw reality as an impermanent constant process of flux and denied that objects had any real substance within them, but rather were ever changing occasions. This is similar to the Buddhist concepts of the impermanence and emptiness. Whitehead also held that each one of these processes was never independent, but was interrelated and dependent all prior occasions, and this feature of reality which he called 'creativity' has been compared to dependent origination which holds that all events are conditioned by multiple past causes. Like Buddhism, Whitehead also held that our understanding of the world is usually mistaken because we hold to the 'fallacy of misplaced concreteness' in seeing constantly changing processes as having fixed substances.Buddhism teaches that suffering and stress arises from our ignorance to the true nature of the world. Likewise, Whitehead held that the world is "haunted by terror" at this process of change. "The ultimate evil in the temporal world...lies in the fact that the past fades, that time is a 'perpetual perishing'". In this sense, Whitehead's concept of "evil" is similar to the Buddhist viparinamadukkha, suffering caused by change. Whitehead also had a view of God which has been likened to the Mahayana theory of the Trikaya as well as the Bodhisattva ideal.

wittgenstein

Ludwig Wittgenstein held a therapeutic view of philosophy which according to K.T. Fann has “striking resemblances” to the Zen Buddhist conception of the dharma as a medicine for abstract linguistic and philosophical confusion. C. Gudmunsen in his Wittgenstein and Buddhism argues that “much of what the later Wittgenstein had to say was anticipated about 1,800 years ago in India.” In his book, Gudmunsen mainly compares Wittgenstein’s later philosophy with Madhyamaka views on the emptiness of thought and words. Many modern interpreters of Nagarjuna (Jay Garfield, CW Huntington) take a Wittgensteinian or Post--Wittgensteinian critical model in their work on Madhyamaka Buddhist philosophy. Ives Waldo writes that Nagarjuna’s criticism of the idea of svabhava (own--being) “directly parallels Wittgenstein’s argument that a private language (an empiricist language) is impossible. Having no logical links (criteria) to anything outside their defining situation, its words must be empty of significance or use.”

arthur schopenhauer

Schopenhauer noted a correspondence between his doctrines and the Four Noble Truths of Buddhism. Similarities centered on the principles that life involves suffering, that suffering is caused by desire (taṇhā), and that the extinction of desire leads to liberation. Thus three of the four “truths of the Buddha” correspond to Schopenhauer’s doctrine of the will. In Buddhism, however, while greed and lust are always unskillful, desire is ethically variable -- it can be skillful, unskillful, or neutral.

For Schopenhauer, Will had ontological primacy over the intellect; in other words, desire is understood to be prior to thought. Schopenhauer felt this was similar to notions of puruṣārtha or goals of life in Vedānta Hinduism.

In Schopenhauer’s philosophy, denial of the will is attained by either:
personal experience of an extremely great suffering that leads to loss of the will to live;
or knowledge of the essential nature of life in the world through observation of the suffering of other people.

However, Buddhist nirvāṇa is not equivalent to the condition that Schopenhauer described as denial of the will. Nirvāṇa is not the extinguishing of the person as some Western scholars have thought, but only the “extinguishing” (the literal meaning of nirvana) of the flames of greed, hatred, and delusion that assail a person’s character. Occult historian Joscelyn Godwin (1945--) stated, “It was Buddhism that inspired the philosophy of Arthur Schopenhauer, and, through him, attracted Richard Wagner. This Orientalism reflected the struggle of the German Romantics, in the words of Leon Poliakov, to “...free themselves from Judeo--Christian fetters.”In contradistinction to Godwin’s claim that Buddhism inspired Schopenhauer, the philosopher himself made the following statement in his discussion of religions:

If I wished to take the results of my philosophy as the standard of truth, I should have to concede to Buddhism pre--eminence over the others. In any case, it must be a pleasure to me to see my doctrine in such close agreement with a religion that the majority of men on earth hold as their own, for this numbers far more followers than any other. And this agreement must be yet the more pleasing to me, inasmuch as in my philosophizing I have certainly not been under its influence [emphasis added]. For up till 1818, when my work appeared, there was to be found in Europe only a very few accounts of Buddhism.

Buddhist philosopher Nishitani Keiji, however, sought to distance Buddhism from Schopenhauer. While Schopenhauer's philosophy may sound rather mystical in such a summary, his methodology was resolutely empirical, rather than speculative or transcendental:

Philosophy ... is a science, and as such has no articles of faith; accordingly, in it nothing can be assumed as existing except what is either positively given empirically, or demonstrated through indubitable conclusions.

Also note:
This actual world of what is knowable, in which we are and which is in us, remains both the material and the limit of our consideration.

The argument that Buddhism affected Schopenhauer's philosophy more than any other Dharmic faith loses more credence when viewed in light of the fact that Schopenhauer did not begin a serious study of Buddhism until after the publication of The World as Will and Representation in 1818. Scholars have started to revise earlier views about Schopenhauer's discovery of Buddhism. Proof of early interest and influence, however, appears in Schopenhauer's 1815/16 notes about Buddhism. They are included in a recent case study that traces Schopenhauer's interest in Buddhism and documents its influence. Other scholarly work questions how similar Schopenhauer's philosophy actually is to Buddhism

influences

Schopenhauer said he was influenced by the Upanishads, Immanuel Kant and Plato. References to Eastern philosophy and religion appear frequently in his writing. As noted above, he appreciated the teachings of the Buddha and even called himself a Buddhist. He said that his philosophy could not have been conceived before these teachings were available.

Concerning the Upanishads and Vedas, he writes in The World as Will and Representation:

If the reader has also received the benefit of the Vedas, the access to which by means of the Upanishads is in my eyes the greatest privilege which this still young century (1818) may claim before all previous centuries, if then the reader, I say, has received his initiation in primeval Indian wisdom, and received it with an open heart, he will be prepared in the very best way for hearing what I have to tell him. It will not sound to him strange, as to many others, much less disagreeable; for I might, if it did not sound conceited, contend that every one of the detached statements which constitute the Upanishads, may be deduced as a necessary result from the fundamental thoughts which I have to enunciate, though those deductions themselves are by no means to be found there.

buddhism and mathematics

buddhist logics

Buddhist logic, the categorical nomenclature modern Western discourse has extended to Buddhadharma traditions of ‘Hetuvidya’ (Sanskrit) and ‘Pramanavada’ (Sanskrit), which arose circa 500CE, is a particular development, application and lineage of continuity of ‘Indian Logic’, from which it seceded. Indian logic, and Buddhist Logic--in main heralded by Dignāga (c. 480 -- 540 CE)--are both primarily studies of ‘inference’-- patterns, where ‘inference’ is a gloss of anumāna (Sanskrit).

Sadhukhan, et al. frames the centrality of ‘syllogism’ to Buddhist Logic and foregrounds its indivisibility as an investigative, authenticating and proofing tool instituted to establish the valid cognitive insights of the Buddhadharma:

Buddhist logic obviously contains the forms and nature of syllogism, the essence of judgement, etc. for which it deserves the name of logic. But that logic is not only logic it also establishes the doctrines of the Buddhists. Thus the philosophical tenets were the fulcrum and the logic developed as tools to establish those.

Following the work of Tucci (1929) and the critique of Anacker (2005, rev.ed.) upon the collation of Frauwallner (1957), it is now understood that Vasubandhu’s Vāda--vidhi (“A Method for Argumentation”) refined the five argument logic of the Nyāya--sūtra to a three argument form and not his pupil Dignāga. In addition to pruning the two redundant arguments from the syllogism, Vasubandhu tendered a further qualification: he posited that a sound relationship, a ‘logical pervasion’ (vyapti) needs to be defined between the first and second arguments, a relationship between the ‘Demonstrandum’ (pratijna) and the ‘Justification’ (hetu) that is assumed in the Nyāya--sūtra and other literature of the Nyāya school. This logical pervasion is required to fashion sound arguments. Vasubandhu’s Vāda--vidhi was reconstructed by Frauwallner from embedded quotations harvested from the works of Dignāga, amongst others. Dignāga as the oft--cited wellspring of the logical triune in the Buddhadharma is now invalidated.

the bodhisattva ideal

At the core of Buddhism is karutā/compassion for the dukkha/suffering of the world. Siddhartha Gautama realized this compassion in the enlightenment experience when he achieved nirvāna as the Buddha. We all know the story of the prince destined to alleviate the world’s ills and serve as the great healer. After leading a sheltered hedonistic lifestyle, Siddhartha came into contact with the reality of dukkha: the suffering of destitution, sickness, old age and death. Motivated by his compassion to find a cure for these tragedies of life and existence, Siddhartha turned to the way of the arhant. This part of his journey led him down the path of denial in the attempt to root out the problems of desire. However, this lifestyle of asceticism only provided a transformed mode of suffering that mirrored that of pleasure. In hedonism the ātman/ self is fed and cultivated; in asceticism the intention is to destroy and annihilate the ātman. Both ways of life assume the existence of the self, though each attempts to treat it differently; and yet they both end by giving in to the demands of desire. Siddhartha’s great insight was to see through these extremes and find the middle way between them.

He realized this awakening over the course of a miraculous meditation in becoming the Buddha, whereupon he gained an understanding that showed him the truth of existence grounded in his universal compassion for all suffering beings. Nāgarjuna sums this up succinctly, “Compassion is a mind that savours only / Mercy and love for all sentient beings.” About seven centuries later, Śāntideva asserts, “...one adopts that Spirit [of Awakening (and compassion)] with an irreversible attitude for the sake of liberating limitless sentient beings... to remove the incomparable pain of every single being...striving for the complete happiness of all sentient beings.” We have seen unfurl over the historical course of Buddhism the conviction that “the Tathagata has taught [the Dharma] for the weal of beings who have set out in the best, in the most excellent of vehicle[s],” that is, Mahāyāna. The Buddha’s enlightenment as described in the Prajñāpāramitā literature is the “allayer of all suffering.”

The truth of existence is taught in the four noble truths about suffering: there is suffering, the arising of suffering, the cessation of suffering, and the path out of suffering. Suffering arises from desire and the attachment/upādāna to desire and the

objects of desire. The object, that is, the complex phenomena that we have objectified, and which we most crave for, is an actually existent self, which we (mistakenly) believe to be real. This is obvious in hedonism, but in asceticism one needs to make the dialectical move to understand that the desire to obliterate the self implicitly relies on holding that the self actually exists as something that can be annihilated. “Thus neither self nor non--self / Are understood as real, / Therefore the Great Subduer rejected / The views of self and non--self.” The craving for the self drives these extreme views. To overcome the suffering endemic to such views, the noble truths teach of the Buddha’s insights into anātman/non--self.

Anātman expresses the reality of pratītya--samutpāda/relational origination that explains the interdependence of all phenomena. The so-- called self is actually a composite entity (the five--aggregates/pañcaskandha), named and identified with language. “So the conception of ‘I’ exists / Dependent on the aggregates, / But like the image [in a mirror] of one’s face / In reality the ‘I’ does not exist.” Such denotation of the self as “I” is delusory for it covers over and hides the essentially dynamic and relational unfolding of experience by seemingly entifying and freezing desired phenomena into concrete and stable structures. For our conventional needs (or truths) this is satisfactory, but when we reify and absolutize these existential claims, such as in the case of believing in and grasping after an actually existing self, then suffering (due to delusion) arises. In this vein, the Buddha’s middle way aids us in avoiding such mistakes. The cultivation of the middle way requires following the path out of suffering.

The path out of suffering is the Eight--Fold Noble Path, wherein we find the core of Buddhist ethics and morality. According to David Keown, the noble path has three main legs, like a tripod: wisdom, mental discipline, and ethical practice. The scope of the present study does not permit the exploration of the various virtues and their interpretations in the different Buddhist traditions;30 rather, I will confine myself here to the general Mahāyāna evaluation and deployment of the noble path. In the Mahāyāna tradition we find the development of the bodhisattvacarya, the ideal or way of the enlightened being. According to G. M. Nagao,

...The term Bodhisattva itself is to be understood in two ways: the one is Bodhisattva as a Buddha--to--be (ascending, from sattva to Bodhi) and the other is Bodhisattva as a celestial being, or a Bodhi--being, such as Avalokiteśvara, Mañjuśrī, and so on. The activities of such celestial beings, who come down from the state of Buddhahood, which is inactive and immovable, are seen in this world as the activities of a Bodhisattva.

These two aspects of the bodhisattva are complementary: the ascending practitioner is guided by the enlightened wisdom (and virtues) of the celestial beings, whereas the celestial beings save others from suffering through their perfected inactivity. The bodhisattva, as found in sansāra aiming to ascend, is an enlightened practitioner who seeks, but refuses to take that final leap into nirvāna based solely on his/her universal compassion for all suffering creatures: “Through his [the bodhisattva’s] great compassion he feels pain / For the world and so stays in it long.” As my colleague Wing--Cheuk Chan once wrote, “For Mahayana Buddhism, in order to become a Buddha, one has first to be a Bodhisattva. A Bodhisattva is a person who has already been Enlightened. But for the benefit of the other, the Bodhisattva does not enter Nirvana by himself/herself. Rather, a Bodhisattva will only enter Nirvana when all the other sentient beings become Enlightened.” We find this ideal in Hua--yen Buddhism expressed by Fa--Tsang: “Even though [the bodhisattva] has the ability to freely extinguish the obstacles of defilements from the first stage on, [s/] he deliberately retains them and does not extinguish them. Why? In order to nourish rebirth and attract and convert others.” To this effect, the bodhisattva takes a vow, which The Diamond Sutra describes thusly: “As many [living] beings as there are in the universe of beings...all of these I must lead to Nirvana, in the realm of Nirvana which leaves nothing behind. And yet, although innumerable beings have thus been led to Nirvana, no being at all has been lead to Nirvana.” This latter statement exemplifies the bodhisattva’s insight into the emptiness/śūnyatā? of all temporal beings, their nonself-- existence/nisvabhāva: “Remaining in the cycle of existence for the sake of those suffering due to delusion is achieved through freedom from attachment and fear. This is the fruit of emptiness.” But it is the former statement from The Diamond Sutra that holds our concern here, for the bodhisattva deliberately chooses to aid all others and will continuously strive

to do so, based on his or her compassion for their suffering. “The Bodhisattvas through their compassion / Lead these limitless sentient beings / Out of suffering and establish / Them definitely in Buddhahood.” This establishment in Buddhahood will be taken up in the conclusion, but we must realize that the bodhisattva motivated by compassion consciously makes this decision, which is seemingly rational in character.

Compassion has a universal scope for it applies to all sentient beings who are subject to dukkha and whose number “has no limit.” Śāntideva echoes this sentiment: “So may I be in various ways a source of life for the sentient beings present throughout space until they are all liberated.” Yet this is coupled with the recognition that “While I have promised to liberate beings throughout space...I have not liberated even myself from mental afflictions.” These mental afflictions/kleśas are indicative of the karma such persons continue to produce. Ultimately the bodhisattva understands that these afflictions are empty, just as the self “is”. But can we say that this choice and promise by the bodhisattva to liberate all those who suffer have a rational character or component (even if only secondary in character)?

Perhaps an analogy with an example from the Western Tradition can help illustrate the rationale behind the bodhisattva’s thoughtful judgment; and since this is only an analogy, there is no exact equivalence implied. During the trial of Socrates, Plato recounts part of Socrates’ defence in the Apology: But you have just admitted that the good do their neighbours good, and the evil do them evil. Now is that a truth which your superior wisdom has recognized thus early in life and am I, at my age [of almost 70 years], in such darkness and ignorance as not to know that if a man with whom I have to live is corrupted by me, I am very likely to be harmed by him, and yet I corrupt him, and intentionally, too? That is what you are saying and of that you will never persuade me or any other human being. In other words, it makes no sense to intentionally promote and teach evil ways to others because those others will reciprocally turn around and harm and corrupt the very same instructor. What is more sensible, that is, rational is to teach (or exemplify) good and beneficial behaviour, for this will provide “a positive feedback loop,” if you will. Yet, where the instructed good will benefit the teacher in its own turn (and here is one of the limits of the analogy), the bodhisattva ought to “Provide help to others / Without hope of reward.” Taking this even further, Śāntideva proclaims, “For the sake of accomplishing the welfare of all sentient beings, I freely give up my body, enjoyments, and all my virtues of the three times.” He also examines the role of introspection in this regard: “The perfection of generosity is interpreted simply as a state of mind due to the intention of giving away everything, together with the fruits of that, to all people...When the mind of renunciation is obtained, that is considered the perfection of ethical discipline.” Furthermore, he states, “I am unable to restrain external phenomena, but I shall restrain my own mind.” These assertions are similar to Kant’s propositions regarding duty, for a dutiful act’s worth is independent of the consequences that result from such a deed; yet, in this case, the giving away of “the fruits of that” means that the effects of this virtue are also important for they can lead others out of suffering. This goal is achievable through moral practice, as well as meditation and the development of wisdom.

Though the aforementioned deontological ideal seems to mirror the Buddhist doctrine, there is a more pragmatic understanding intrinsic to the bodhisattva’s position: “Therefore knowing how actions / And their effects agree, / For your own sake help beings / Always and so help yourself.” In doing such, as Socrates foresaw, the moral path is the intelligent path. Śāntideva warns that mindfulness ought never to be displaced: “When one intends to move or when one intends to speak, one should first examine one’s own mind and then act appropriately with composure”--and, we can add, compassion. We can hear the Buddhist spin on this in Nagarjuna’s rhetorical question: “Who with intelligence would deride / Deeds motivated by compassion...?” To aid and be concerned for others is the most meritorious (and intelligent) fashion by which to cultivate selflessness under the Mahāyāna ethos. In aiding

others, lessening their suffering, even if it means taking such upon oneself, and espousing the Dharma, the bodhisattva practitioner moves others and themselves towards enlightenment: “... one should always strive for the benefit of others. Even that which is prohibited has been permitted for the compassionate one who foresees benefit,” that is, the liberation from suffering. In this context, it is the bodhisattva’s conduct that is indicative

of their personal commitment to compassionate action: “I should eliminate the suffering of others because it is suffering, just like my own suffering. I should take care of others because they are sentient beings, just as I am a sentient being.” In this vein, Buddhist śīla is illustrative, for it “represents an internally enforced ethical framework around which any Buddhist practitioner might structure his/her life. From this perspective, śīla is an enormously rich concept for understanding individual ethical conduct,” though for the bodhisattva such comportment aims at both individual and universal (social) enlightenment. Thus the universal extension of karutā becomes the vehicle for nirvāa.

The bodhisattva ought not to follow these ethical guidelines simply because they are accepted dogma, nor simply because they satisfy some secret desire that makes one happy for helping others, or masochistically allows one to revel in the self--sacrifice called for in doing without reward. “You [the bodhisattva] should always well analyse / Everything before you act, / Through seeing things just as they are / You will not rely on others.”

This would agree with Cook’s straightforward statement about Hua--yen, “to act compassionately means to act in accordance with reality.” Reality must be herein approached with the right attitudes, intentions and understanding; in this sense, both sasāra and nirvāa are śūnya. Śāntideva admonishes the adopters of the “Spirit of Awakening”: “Always vigilantly strive not to neglect [one’s] training. Although one has made a commitment, it is appropriate [to reconsider] whether or not to do that which has been rashly undertaken and which has not been well considered”--for while one has promised to liberate all sentient beings, one may not have liberated even oneself from mental afflictions. Thinking before acting seems primary and practical, for there are cognitive (relational) conditions to the bodhisattva’s ethical actions. We saw this also with the Kantian categorical imperative, for the legislation of a universal law via an act of the will necessitates the construction of a priori principles of volition, which determine the moral worth of the act. Likewise the bodhisattva is admonished to think for him/herself without relying on or being unduly influenced by heteronomous (to use Kant’s language) factors imposed by the world, others, or his/her own desires and empirical natures. This point requires clarification: the bodhisattva who views the

world through compassion and right understanding is experientially aware of, and open to, the emptiness of the dharmas that flow in sasāra. In other words, the bodhisattva’s insight into pratītya--samutpāda entails the recognition that there is nothing but nonself-- existent (nisvabhāva) heteronomous elements of experience. These are all empty of self--existence, which does not accord with Kant’s notion of autonomy that requires the existence of an agent qua transcendental subject. Thus while the bodhisattva acts from the (non--) perspective of anātman and karuā, the Kantian agent acts from the perspective of an ideal self and pure practical reason. Furthermore, the freedom that the bodhisattva experiences is that of moka from dukkha, whereas Kant’s freedom is that of an autonomous subject giving itself the moral law unadulterated by phenomenal experience.

The ethical actions performed by a bodhisattva can be refined over the course of “recurring and unending experience,” such that “Through not wavering you [the bodhisattva to be] will attain awareness, / And intelligence through thinking; through respect / You will realise what the doctrines mean, / Through their retention you will become wise.” Though we should not conflate this use of respect with Kant’s conceptualization, the intent is clear enough: wisdom will be supplemented (as it is one leg in the tripod of the noble path--see above),

and even gained through the consistent deployment of thinking and acting in virtuous, ethical and moral manners. This thinking is associated with intelligence, which implies a rational character; however, this intelligence is not meant to be equated or identified with Kantian rationality per se. “Bodhisattvas also who have seen it thus, / Seek perfect enlightenment with certainty, / They maintain a continuity of existence / Until enlightenment only through their compassion.” karutā in this regard is deployed universally, and it is this characteristic (lakana) that drives this comparative project. The recognition that suffering is universal is a rational understanding. We have thus seen that the bodhisattva is moved by his/her compassion to aid all who suffer, doing so with intelligence. The extension of compassion as a universal ideal parallels the universality of the Kantian moral law that is grounded in the rational emotion of respect. But should we then conclude that Buddhist karutā functions in an analogous fashion as Kant’s pure practical reason?

CONCLUSION

I described above how Kant’s kingdom of ends unfolds from the deployment of the categorical imperative. As the universality of the moral law is put into practice, a union of rational beings occurs, wherein they ought to treat each other as free and autonomous agents worthy of respect because they are all instantiations of an identical moral law. Comparably, we find in the Mahāyāna tradition the ubiquity of Buddhanature: “Sentient beings have the best portion of emerging qualities of a Buddha. One should honour sentient beings in accordance with that share.” Likewise we find the bodhisattva aiming at a social ideal similar to the kingdom of ends, the creation of “harmonious Buddhafields,” here explained by E. Conze: A Buddhafield is a part of the world in which a Buddha matures beings. As a harmonious structure it is compared to an orderly and well--arranged military array. In contradistinction to an ordinary, defiled world such as ours, in a ‘Pure Land’ all is beauty and order... The force of their meritorious karma enables the Bodhisattva to realize, or to bring to perfection, a Pure Land, an unworldly world, a ‘heaven’ or ‘paradise’ which offers ideal conditions for rapid spiritual progress. This spiritual utopian vision is realized through the bodhisattva’s compassion for the suffering in the mundane world, because such “compassion is not limited to an inner attitude, but is identified with practical action.” We can also hear echoes of Kant’s kingdom of ends in the orderliness and beneficial arrangements of such social structures, for these reverberate like the system of universal laws of the good will. Herman describes an important example of this in Kant’s moral philosophy:

As a person’s true needs are those that must be met if [she/]he is to function (or continue to function) as a rational, end--setting agent, respecting the humanity of others involves acknowledging the duty of mutual aid: one must be prepared to support the conditions of the rationality of others (their capacity to set and act for ends) when they are unable to do so without help. The duty to develop (not neglect) one’s talents and the duty of mutual aid are thus duties of respect for persons. The motivation to help others in the Kantian context explicitly intends to enable the rationality of others, but it also must exercise a material

Nāgarjuna

top 10 mathematical innovations

Of all the mathematical innovations since ancient times, only some are worthy of multicentenary celebrations. Certainly logarithms, celebrating their 400th anniversary this year, are among them. Ranking where logarithms rate among the rest is subjective, of course, but I'd put them 10th (they'd be higher if everybody still used slide rules, though). Here are the rest of my Top 10 mathematical innovations, which you might as well read here because David Letterman isn't going to get to them before he retires:

10. LOGARITHMS (JOHN NAPIER, JOOST BÜRGI, HENRY BRIGGS)
A great aid to anybody who multiplied or messed with powers and roots, logarithms made slide rules possible and clarified all sorts of mathematical relationships in various fields. Napier and Bürgi both had the basic idea in the late 16th century, but both spent a couple of decades calculating log tables before publishing them. Napier's came first, in 1614. Briggs made them popular, though, by recasting Napier's version into something closer to the modern base--10 form.

9. MATRIX ALGEBRA (ARTHUR CAYLEY)
An ancient Chinese math text included matrix--like calculations, but their modern form was established in the mid--19th century by Cayley. (Several others, including Jacques Binet, had explored aspects of matrix multiplication before then.) Besides their many other applications, matrices became extremely useful for quantum mechanics. In fact, in 1925 Werner Heisenberg reinvented a system identical to matrix multiplication to do quantum calculations without even knowing that matrix algebra already existed.

8. COMPLEX NUMBERS (GIROLAMO CARDANO, RAFAEL BOMBELLI)
Before Cardano, square roots of negative numbers had shown up in various equations, but nobody took them very seriously, regarding them as meaningless. Cardano played around with them, but it was Bombelli in the mid--16th century who worked out the details of calculating with complex numbers, which combine ordinary numbers with roots of negative numbers. A century later John Wallis made the first serious case that the square roots of negative numbers were actually physically meaningful.

7. NON--EUCLIDEAN GEOMETRY (CARL GAUSS, NIKOLAI LOBACHEVSKY, JÁNOS BOLYAI, BERNHARD RIEMANN)
Gauss, in the early 19th century, was probably the first to figure out an alternative to Euclid's traditional geometry, but Gauss was a perfectionist, and perfection is the enemy of publication. So Lobachevsky and Bolyai get the credit for originating one non--Euclidean approach to space, while Riemann, much later, produced the non--Euclidean geometry that was most helpful for Einstein in articulating general relativity. The best thing about non--Euclidean geometry was that it demolished the dumb idea that some knowledge is known to be true a priori, without any need to check it out by real--world observations and experiments. Immanuel Kant thought Euclidean space was the exemplar of a priori knowledge. But not only is it not a priori, it's not even right.

6. BINARY LOGIC (GEORGE BOOLE)
Boole was interested in developing a mathematical representation of the "laws of thought," which led to using symbols (such as x) to stand for concepts (such as Irish mathematicians). He hit a snag when he realized that his system required x times x to be equal to x. That requirement pretty much rules out most of mathematics, but Boole noticed that x squared does equal x for two numbers: 0 and 1. In 1854 he wrote a whole book based on doing logic with 0s and 1s -- a book that was well--known to the founders of modern computer languages.

5. DECIMAL FRACTIONS (SIMON STEVIN, ABU'L HASAN AL--UQLIDISI)
Stevin introduced the idea of decimal fractions to a European audience in a pamphlet published in 1585, promising to teach "how all Computations that are met in Business may be performed by Integers alone without the aid of Fractions." He thought his decimal fraction approach would be of value not only to merchants but also to astrologers, surveyors and measurers of tapestry. But long before Stevin, the basic idea of decimals had been applied in limited contexts. In the mid--10th century, al--Uqlidisi, in Damascus, wrote a treatise on Arabic (Hindu) numerals in which he dealt with decimal fractions, although historians differ on whether he understood them thoroughly or not.

4. ZERO AND 3. NEGATIVE NUMBERS (BRAHMAGUPTA)
Brahmagupta, a seventh--century Hindu astronomer, was not the first to discuss negative numbers, but he was the first to make sense of them. It's not a coincidence that he also had to figure out the concept of zero to make negative numbers make sense. Zero was not just nothingness, but a meaningful number, the number you get by subtracting a number from itself. "Zero was not just a placeholder," writes Joseph Mazur in his new book Enlightening Symbols. "For what may have been the first time ever, there was a number to represent nothing."

2. CALCULUS (ISAAC NEWTON, GOTTFRIED LEIBNIZ)
You know the story -- Newton gets all the credit, even though Leibniz invented calculus at about the same time, and with more convenient notation (still used today). In any event, calculus made all sorts of science possible that couldn't have happened without its calculational powers. Today everything from architecture and astronomy to neuroscience and thermodynamics depends on calculus.

1. ARABIC NUMERALS
Did you ever wonder why the Romans didn't do much creative quantitative science? Try doing a complicated calculation with their numerals. Great advances in Western European science followed the introduction of Arabic numerals by the Italian mathematician Fibonacci in the early 13th century. He learned them from conducting business in Africa and the Middle East. Of course, they should really be called Hindu numerals because the Arabs got them from the Hindus. In any case, mathematics would be stuck in the dark ages without such versatile numerals.

applied buddhism in modern mathematics

according to top 10 mathematical innovation...

The concept of 'zero' or 'sunyam' originated in ancient India. It was derived from the concept of 'void' or 'śūnyatā ' propagated by Nāgārjuna through his Doctrine of Emptiness or 'śūnyatā '. However, the concept of 'void' existed in Hindu Philosophy before Nāgārjuna. There also existed the derivation of a symbol for it. The early Vedic concept of 'śūnyatā 'or 'void' was later refined by Nāgārjuna who had imparted an intensive philosophical meaning to it.

Nāgārjuna's doctrine of 'śūnyatā' provided the foundation for Mahāyāna and Vajrāyāna (Tantrāyāna) forms of Buddhism. This Doctrine of Emptiness had deep rooted origin in the Buddha's Doctrine of Dependent Origination or Impermanence. The concept of 'śūnyatā' was influenced by South--east Asian culture through the Buddhist concept of 'Nibbana' which means 'attaining salvation by merging into the void of eternity'.

A concept and symbol that connotes nullity represents a qualitative advancement of the human capacity of abstraction. In absence of a concept of 'zero' there could have been only positive numerals in computation, the inclusion of 'zero' in mathematics opened up a new dimension of negative numerals and gave a cut--off point and a standard in the measurability of qualities whose extremes are still unknown to human beings, such as temperature. Though the exact age of origin of 'zero' in Indian mathematics is still unknown, but the archeological evidence of 'zero' and 'Decimal System of numerals' during the Buddhist period were found on the Rock Edits of Ashoka (256 B.C.).

emptiness

the buddhist concept of ‘śūnyatā’ or ‘emptiness’

In early Buddhism, the term ‘suññatā’ or ‘śūnyatā’ is used primarily in connection with the ‘no--self’ (anatman) doctrine to denote that the Five Aggregates (skandhas) are ‘empty’ of the permanent self or soul which is erroneously imputed to them.1 The doctrine of emptiness, however, received its fullest elaboration by Nāgārjuna, who wielded it skillfully to destroy the substantiality conceptions of the Abhidharma schools of the Theravāda. Since there cannot be anything that is not the Buddhanature (buddhatā), all that appears is in truth devoid of characteristics. The doctrine of emptiness is the central tenet of the Mādhyamaka School. A statement of Nāgārjuna’s views in support of it may be found in his Mūla--Mādhyamaka--Nārikā.

Nāgārjuna is regarded as the founder of the Mādhyamaka school of Mahāyāna Buddhist philosophy which he had established during the 2nd--3rd Century A.D. The ‘Mulamadhyamaka--Karika’ (“Fundamentals of the Middle Way”) is his major work. It was originally composed in Sanskrit. The Sanskrit as well as early Tibetan versions of the work had survived without significant damage over the ages along with the later Chinese translations. Several complete English translations of the ‘Karika’ are available in recent times.

Teachings of
Siddhartha Gautama

evolution of the concept of ‘zero’ in modern mathematics

In mathematics the notion of emptiness finds expression in the number ‘zero’, as well as in contemporary set theory. The concept of ‘zero’ was discovered in India prior to the third century A.D. The “Arabic” number system we use today is neither Arabic nor Greek in origin. In fact, the digits 0123456789 go back to India where they were first created. The ancient Indian number system distinguished itself from other positional systems by virtue of allowing the use of ‘zero’ as a legitimate number. The number ‘zero’ did not exist in Greek mathematics, because the Greeks were essentially geometricians and had no use for the mathematical concept of a non--entity. The concept of ‘zero’ also did not exist in Egyptian mathematics. The Arabs, who encountered the Indian number system during their early conquests in India, found it superior to their own traditional system which used alphabets, and had adapted it to develop Islamic mathematics. The Arabic word for ‘zero’ is “sifr”, meaning “empty.” In the 12th century, the Italian mathematician Leonardo Pisano Fibonacci studied Arabian algebra and introduced the Hindu--Arabic numerals to Europe. The word “sifr” got transformed into “zephirum” in Latin and subsequently, ‘zero’ in English.1,5

During the first three centuries A.D., the ancient Indians were already using a decimal positional system on a wide scale. In this system, the numerals in different positions represent different numbers and here, one of the ten symbols used was a fully functional ‘zero’. They called it ‘Sunyam’. The word and its meaning ‘void’ were obviously borrowed from its use in philosophical literature. Eventually, the Decimal System of calculation evolved from this, which laid the foundation for all the modern arithmetic, mathematics and statistics.

the babylonian system of numerals

In all early civilizations, the first expression of mathematical understanding appears in the form of counting systems. Numbers in very early societies were typically represented by groups of lines, though later different numbers came to be assigned specific numeral names and symbols (as in India) or were designated by alphabetic letters (such as in Rome). Although today, we take our decimal system for granted, not all ancient civilizations based their numbers on a ten--base system. In ancient Babylon, a hexagesimal (base 60) system was in use. Though the Babylonians used a special symbol for ‘zero’ as early as the 3rd century B.C., they used it only as a place holder and did not have the concept of ‘zero’ as an actual value.

Compared to the Indian system of mathematical calculations, the Babylonian numeration had only three figures, one for 1, one for 10, and one for 100, so that a number, say, 999, would require 27 symbols, namely, nine of each of the symbols. But it is not certain when exactly the invention of this most modest of all numerals took place. The first time it reached Europe was during the Moorish invasion of Spain around 700 A.D. Later, when massive Latin translations of books from Baghdad took place around the close of the first millennium A.D., the concept was found in an arithmetic book dated 820 A.D., by Muhammad Ibn Musa al--Khouarizmi , who explained the whole Decimal System in great detail. It was actually the Indian system that explained as the Arabs themselves had no number system of their own.

The Maya civilization of South America also had a ‘zero’ in the first century A.D., but they did not use it in a fixed base system. The Greeks were hampered by their use of letters for the numbers. Before ‘zero’ was invented, the art of reckoning remained an exclusive and highly skilled profession. It was difficult to distinguish, say, 27, 207, 270, 2007, because the latter three were all written 2 7, with a ‘space’ in between. The positional system is not possible in the Roman numeral system which had no expression or symbol for ‘zero’. A number, say, 101,000, would have to be written only by 101 consecutive M’s. The Egyptians had no ‘zero’ and never reached the idea of expressing all numbers with ten digits.

the evolution of indian numeral system

Although the Chinese were also using a decimal based counting system in ancient times, they lacked a formal notational system that had the abstraction and elegance of the Indian notational system. It was the Indian notational system that reached the Western world through the Arabs and has now been accepted as universal. Several factors contributed to this development whose significance is perhaps best stated by French mathematician, Laplace: “The ingenious method of expressing every possible number using a set of ten symbols (each symbol having a place value and an absolute value) emerged in India. The idea seems so simple nowadays that its significance and profound importance is no longer appreciated. Its simplicity lies in the way it facilitated calculation and placed arithmetic foremost amongst useful inventions.”

(a) THE DECIMAL SYSTEM IN HARAPPA

The mathematical environment among the Indians was congenial for the invention of ‘zero’ and for its use as the null--value in all facets of calculation. In India a decimal system was already in place during the Harappan period, as indicated by an analysis of Harappan weights and measures. Weights corresponding to ratios of 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100, 200, and 500 have been identified, as have scales with decimal divisions. A particularly notable characteristic of Harappan weights and measures is their remarkable accuracy. A bronze rod marked in units of 0.367 inches points to the degree of precision demanded in those times. Such scales were particularly important in ensuring proper implementation of town planning rules that required roads of fixed widths to run at right angles to each other, for drains to be constructed of precise measurements, and for homes to be constructed according to specified guidelines. The existence of a gradated system of accurately marked weights points to the development of trade and commerce in Harappan society.

(b) MATHEMATICAL ACTIVITY IN THE VEDIC PERIOD

In the Vedic period, records of mathematical activity are mostly to be found in Vedic texts associated with ritual activities. However, as in many other early agricultural civilizations, the study of arithmetic and geometry was also impelled by secular considerations. Thus, to some extent early mathematical developments in India mirrored the developments in Egypt, Babylon and

China. The system of land grants and agricultural tax assessments required accurate measurement of cultivated areas. As land was redistributed or consolidated, problems of mensuration came up that required solutions. This meant that an understanding of geometry and arithmetic was virtually essential for revenue administrators. Mathematics was thus brought into the service of both the secular and the ritual domains.

Arithmetic operations (Ganit) such as addition, subtraction, multiplication, fractions, squares, cubes and roots are enumerated in the Narad Vishnu Purana attributed to Ved Vyas (pre--1000 BC). Examples of geometric knowledge (rekha--ganit) are to be found in the Sulva--Sutras of Baudhayana (800 BC) and Apasthmaba (600 BC) which describe techniques for the construction of ritual altars in use during the Vedic era. It is likely that these texts tapped geometric knowledge that may have been acquired much earlier, possibly in the Harappan period. Baudhayana's Sutra displays an understanding of basic geometric shapes and techniques of converting one geometric shape (such as a rectangle) to another of equivalent (or multiple, or fractional) area (such as a square). While some of the formulations are approximations, others are accurate and reveal a certain degree of practical ingenuity as well as some theoretical understanding of basic geometric principles. Modern methods of multiplication and addition probably emerged from the techniques described in the Sulva--Sutras.

A notation for powers of 10 up to the power 17 was already in use even from Vedic times. Single words had been used to denote the powers of the number 10. The numbers one, ten, hundred, thousand, ten thousand, … were given by the sequence of words in the list: eka, dasa, śata, sahasra, ayuta, laksha, prayuta, koţi, arbuda, abja, kharva, nikharva, mahā--padma, śankha, jaladhi, antya, mahāśankha, parārdha. Thus, the Decimal System was in Indian culture even in the early part of the first millennium B.C. The Yajurveda, in its description of rituals and the mantras employed therein, the Mahabharata and the Ramayanā in their descriptions of statistics and measurements used all these words with total abandon. However, distinct symbols for the numbers 1 to 9 already existed in the Indian system of calculations and the counting system used the base 10 in all its secular, religious and ritual activities.

These two factors were unique to Indian culture and contributed most to the thought process that led to the decimal place value notation as well as 'zero' having a value.

(c) BRAHMINICAL PHILOSOPHY AND MATHEMATICS

Indian philosophical doctrines also had a profound influence on the development of mathematical concepts and formulations. In the Upanishadic world view of Brahmanism, space and time were considered limitless. This led to a deep interest in developing very large numbers and evolution of the definitions of infinite numbers. Infinite numbers were created through recursive formulae, as in the Anuyoga Dwara Sutra.

(d) PHILOSOPHY OF JAINISM AND MATHEMATICS

Like the Upanishadic world view, the Jain cosmology also regarded space and time as limitless. Jain mathematicians recognized five different types of infinities that included, infinite in one direction, in two directions, in area, infinite everywhere and perpetually infinite. Since Jain epistemology allowed for a degree of indeterminacy in describing reality, it probably helped in grappling with indeterminate equations and finding numerical approximations to irrational numbers. Permutations and combinations are listed in the Bhagvati Sutras (3rd C BC) and Sathananga Sutra (2nd C BC). In Satkhandagama, various sets are operated upon by logarithmic functions to base two, by squaring and extracting square roots, and by rising to finite or infinite powers. The operations are repeated to produce new sets. In other works the relation of the number of combinations to the coefficients occurring in the binomial expansion is noted.

(d) BUDDHIST PHILOSOPHY AND MATHEMATICS

Buddhist literature also demonstrates an awareness of indeterminate and infinite numbers. Buddhist mathematics was classified either as Garna (Simple Mathematics) or Sankhyan (Higher Mathematics). Numbers were deemed to be of three types: Sankheya (countable), Asankheya (uncountable) and Anant (infinite). Nāgārjuna's Doctrine of Emptiness or Śūnyatā had paved the way for the development of the concept of 'nullity' and 'infinity' in modern mathematics.

(e) CONTRIBUTION OF BRAHMAGUPTA

Philosophical formulations concerning Shunya -- i.e. emptiness or the void may have facilitated in the introduction of the concept of ‘zero’. While the ‘zero’ (bindu) as an empty place holder in the place--value numeral system appears much earlier, algebraic definitions of the ‘zero’ and its relationship to mathematical functions appear in the mathematical treatises of Brahmagupta in the 7th C AD. Although scholars are divided about how early the symbol for ‘zero’ came to be used in numeric notation in India, (Ifrah arguing that the use of ‘zero’ is already implied in Aryabhatta) tangible evidence for the use of the ‘zero’ begins to proliferate towards the end of the Gupta period. Between the 7th C and the 11th C, Indian numerals developed into their modern form, and along with the symbols denoting various mathematical functions (such as plus, minus, square root etc) eventually became the foundation stones of modern mathematical notation.

Counting boards with columns representing units and tens were in use from very ancient times in India. The numberless content of an empty column in course of time was symbolized to be ‘nothing’. The thriving activity in astrology, astronomy, navigation and business during the first few centuries A.D. in India also looked forward for a superior numerical system that lent itself to complicated calculations.

The ancient India astronomer Brahmagupta is credited with having put forth the concept of ‘zero’ for the first time. Brahmagupta is said to have been born the year 598 A.D. at Bhillamala (today’s Bhinmal) in Gujarat, Western India. His name as a mathematician was well established when King Vyaghramukha of the Chapa dynasty made him the court astronomer. Among his two treatises, Brahma--sputa siddhanta and Karanakhandakhadyaka, first one is more famous. It was a corrected version of the old Astronomical text, Brahma siddhanta. It was in his Brahma--sphu siddhanta, for the first time ever that he had formulated the rules of the operation ‘zero’, foreshadowing the Decimal System numeration. With the integration of ‘zero’ into the numerals, it became possible to note higher numerals with limited characters. Since, Nāgārjuna’s Doctrine of Emptiness or Śūnyatā was quite popular in Indian society during the time of Brahmagupta, there is a high probability that Brahmagupta was inspired by this Doctrine of Emptiness. Thus, the philosophical concept of ‘emptiness’ or ‘śūnyatā ’ or ‘void’ gave rise to the concept of ‘zero’ in Indian mathematics. Subsequently, this became the foundation for modern mathematics.

Brilliant as it was, this invention was no accident. In the Western world, the cumbersome Roman numeral system posed as a major obstacle, and in China the pictorial script posed as a hindrance. But in India, almost everything was in place to favor such a development. There was already a long and established history in the use of decimal numbers, and philosophical and cosmological constructs encouraged a creative and expansive approach to number theory. Panini’s studies in linguistic theory and formal language and the powerful role of symbolism and representational abstraction in art and architecture may have also provided an impetus, as might have the rationalist doctrines and the exacting epistemology of the Nyaya Sutras, and the innovative abstractions of the Syadavada and Buddhist schools of learning.

In the earlier Roman and Babylonian systems of numeration, a large number of characters were required to denote higher numerals. Thus, enumeration and computation was a cumbersome process. According to the Roman system of numeration, the number thirty would have to be written as XXX. But as per the Decimal System it would. Similarly, as per the Roman system, the number thirty three would be written as XXXIII. But as per the Decimal System, it would be 33. Thus, it is clear how the introduction of the Decimal System made possible the writing of numerals having a high value with limited characters. This also made computation easier.

Apart from developing the Decimal System based on the incorporation of ‘zero’ in enumeration, Brahmagupta also arrived at solutions for indeterminate equations of 1 type ax2+1=y2 and thus can be called the founder of higher branch of mathematics called numerical analysis. Brahmagupta’s treatise Brahma--sputa--siddhanta was translated into Arabic under the title Sind Hind. For several centuries this translation remained a standard text of reference in the Arab world. It was from this translation of an Indian text on Mathematics that the Arab mathematicians perfected the Decimal System and gave the world its current system of enumeration which we call the Arab numerals, which are originally Indian numerals.

‘zero’ and the place--value notation

Although the Chinese were also using a decimal based counting system in ancient times, they lacked a formal notational system that had the abstraction and elegance of the Indian notational system. It was the Indian notational system that reached the Western world through the Arabs and has now been accepted as universal. Several factors contributed to this development whose significance is perhaps best stated by French mathematician, Laplace: “The ingenious method of expressing every possible number using a set of ten symbols (each symbol having a place value and an absolute value) emerged in India. The idea seems so simple nowadays that its significance and profound importance is no longer appreciated. Its simplicity lies in the way it facilitated calculation and placed arithmetic foremost amongst useful inventions.”

(a) THE DECIMAL SYSTEM IN HARAPPA

The mathematical environment among the Indians was congenial for the invention of ‘zero’ and for its use as the null--value in all facets of calculation. In India a decimal system was already in place during the Harappan period, as indicated by an analysis of Harappan weights and measures. Weights corresponding to ratios of 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100, 200, and 500 have been identified, as have scales with decimal divisions. A particularly notable characteristic of Harappan weights and measures is their remarkable accuracy. A bronze rod marked in units of 0.367 inches points to the degree of precision demanded in those times. Such scales were particularly important in ensuring proper implementation of town planning rules that required roads of fixed widths to run at right angles to each other, for drains to be constructed of precise measurements, and for homes to be constructed according to specified guidelines. The existence of a gradated system of accurately marked weights points to the development of trade and commerce in Harappan society.

application of ‘emptiness’ in modern mathematics

In ancient India the numeral of ‘void’ or ‘sunyam’ was used in computation. It was indicated by a dot and was termed ‘Pujyam’. Even today we use this term for ‘zero’ along with the more current term ‘Sunyam’ meaning a blank. But the term ‘Pujyam’ also means holy. ‘Param--Pujya’ is a prefix used in written communication with elders where it means respected or esteemed. The reason why the term ‘Pujya’, meaning blank, came to be sanctified is still unknown.

Indian philosophy has glorified concepts like the material world being an illusion or ‘Maya’. The act of renouncing the material world is ‘Tyaga’ and the goal of merging into the void of eternity is ‘Nibbana’. The mathematical concept of ‘zero’ might have got a philosophical connotation of reverence from these.

It is possible that like the technique of algebra, the concept of ‘zero’ also reached the west through the Arabs. In ancient India the terms used to describe ‘zero’ included ‘Pujyam’, ‘Sunyam’, ‘Bindu’. The concept of a void or blank was termed as ‘Shukla’ and ‘Shubra’ which also means white or purity. The Arabs referred to the ‘zero’ as ‘Siphra’ or ‘Sifr’ from which we have the English terms Cipher or Cypher. In English the term Cipher connotes ‘zero’ or any Arabic numeral. Thus, it is evident that the term Cipher is derived from the Arabic ‘Sifr’ which in turn is quite close to the Sanskrit term ‘Shubra’.

In the ancient Indian context, the number ‘zero’ did not originally refer to nothingness or nullity. The Sanskrit word for ‘zero’ is ‘sunyam’, which means “puffed up, hollow, empty.” The ‘zero’ stands for emptiness suggestive of potentiality. The discovery of the mathematical ‘zero’ concurred with the emptiness of prajna--intuition in India around 200 BC. The concept of ‘zero’ evolved to signify polar opposition between being and nonbeing. ‘zero’ is that which contains all possible polarized pairs such as (+1, --1), (+2, --2), etc. It is the collection of all mutually cancelling pairs of forward and backward movements. Put it another way, ‘zero’ is fundamental to all existence. Because of it, everything is possible. ‘zero’ is the additive identity, the focal point of all numbers. The numbers cannot be created without the ‘zero’.

Among the great civilizations of antiquity, India alone was able to fathom the depth of emptiness and willing to accept its importance in mathematics. Following the introduction of the Indian--Arabic numerals into Western culture, ‘zero’ became a number that was used in calculations like any other number. Consequently, it lost some part of its original meaning, namely the part that suggests potentiality. Today, most mathematicians do not associate the notion of emptiness with ‘zero’, but with the ‘Empty Set’ which is a construct of set theory. This notion of emptiness is also now associated with the ‘Null Hypothesis Testing’ in statistical methods which is the backbone of modern research. Thus, it is evident that Nāgārjuna’s doctrine of ‘śūnyatā’ provided the foundation for modern epidemiology and biostatistics.

emptiness and null set: the evolution of natural numbers

A set is a collection of objects or numbers. For example, the set { 1, 2, 3, 5, 8 } is a set of numbers containing five elements; it is therefore said to have the “cardinality” of 5. The Null Set or Empty Set { } is a collection that contains nothing and has the cardinality 0. The mathematician John von Neumann (1923) invented a method, known as von Neumann hierarchy, which can be employed to generate the natural numbers from the empty set as follows:

step 0: {}	(empty set)
step 1: {{}}	(set containing the empty set)
step 2: {{},{{}}}	(set containing previous two sets)
step 3: {{},{{}},{{},{{}}}}	(set containing previous three sets)
step {{},{{}},{{},{{}}},{{},{{}},{{},{{}}}}}	(set containing previous four sets etc.)

This sequence is obtained by iterating a function that creates a new set from the union of the preceding two sets, thus generating sets with the cardinalities 0, 1, 2, 3, 4, ad infinitum. In less mathematical terms, the principle can be described as follows: Beginning with emptiness (step 0), we observe emptiness. Through the act of observing we create an entity containing emptiness (step 1). Now we perceive emptiness, as well as an entity. From the combination of the former two we create another entity by observation, which is different from the first entity (step 2). This process is repeated again and again. Interestingly, if we define suitable operations on the obtained sets based on union and intersection, the cardinalities of the resulting sets behave just like natural numbers being added and subtracted. The sequence is therefore isomorphic to the natural numbers -- a stunningly beautiful example of something from nothing.

emptiness and null hypothesis

The concept of ‘nullity’ in the ‘Null Hypothesis’ is the backbone of modern scientific research and statistical methods. The acceptance or rejection of Null Hypothesis is the fundamental basis of our scientific understandings. At the Beginning of any research, the researchers need to take a neutral stand by assuming that a set of suspected correlates or determinants are neither related not non--related to the outcome variable that is examined in the study.

This neutral position by the researchers is actually the application of emptiness in order to remain unbiased throughout the study. However, the Null Hypothesis states that there is no relationship between a correlate or determinant and an outcome. In case any relationship is observed, it is merely due to chance. So, the researchers need to analytically judge from the results of their research findings on whether to accept or reject the Null Hypothesis.

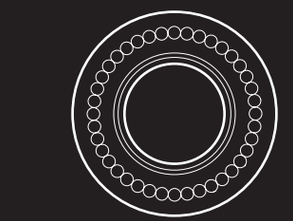
Various probability oriented statistical models are applied to test this Null Hypothesis in every research in order to establish the actual truth by attaching logical and analytical judgment to the findings. All these efforts are directed towards minimizing the chance factor to establish the truth with accuracy in the light of our fundamental understandings and logical reasoning. Nāgārjuna’s doctrine of ‘śūnyatā’ provided the foundation for this insight in modern epidemiology and biostatistics.

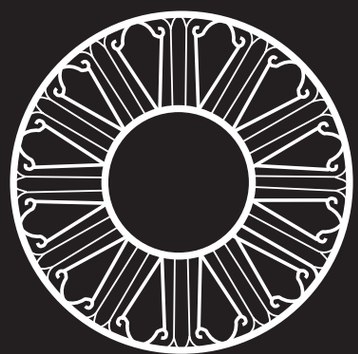
It is interesting to know how the ‘Sunyam’ of the Indians became the ‘zero’ of the modern world. The ‘Sunya’ of Sanskrit became the Arabic ‘sifr’ which means empty space. In Medieval Latin it manifested as ‘ciphra’, then in Middle English as ‘siphre’, in English as ‘cypher’ and in American as ‘cipher’. In the middle ages, the word ‘ciphra’ evolved to stand for the whole system. In the wake of this general meaning, the Latin ‘zephirum’ came to be used to denote the ‘Sunyam’. And that entered English finally as ‘zero’. In medieval Europe, some countries banned the positional number system, along with ‘zero’, brought by the Arabs whom they considered as heathens. So, they considered the ‘Sunyam’ to be a creation of the devil. As a result ‘ciphra’ came to mean a secret code. The term ‘deciphering’ later evolved from this which meant ‘resolution of a code’.

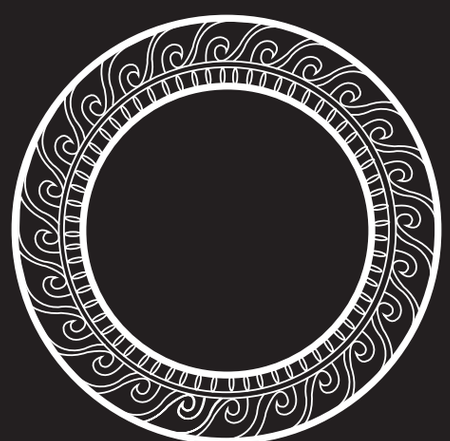
The Decimal System of numerals is known as Indo--Arabic numerals even today. But it is actually a misnomer. The concept of ‘zero’ and ‘Decimal System of numerals’ first evolved in India and was later adopted by the Arabs. The archeological evidence of ‘zero’ and ‘Decimal System of numerals’ were already found on the Rock Edits of Ashoka (256 B.C.) which was curved several centuries earlier than Arab invasion.

Though the concept of ‘zero’ appeared in the Indian history much earlier, but Nāgārjuna gave a new dimension of ‘nullity’ or ‘emptiness’ to the notion of ‘zero’ and made it more meaningful with regard to our philosophical understandings. The historical evidences imply that the Indian contribution of ‘zero’, which had eventually led to the evolution of the Decimal System of numbers, was a significant milestone in modern mathematics and had changed our way of thinking and understanding forever.

forms in buddhism







pain
lamentation
grief
IGNORANCE
sorrow
despair
volitional impulses ---> consciousness ---> body & mind ---> sense bases ---> contact ---> feeling ---> craving ---> clinging ---> becoming ---> birth ---> aging & death…

Dependent arising
the Wheel of life
ignorance
formation
consciousness
mind/body
6 sense bases
contact
feeling
craving
attachment
becoming
birth
suffering

discussion;

From all subject of this research, In brief, the principle of dependent origination can be understood in the following three ways. First, all conditioned things and events in the world come into being only as a result of the interaction of causes and conditions. They don't just arise from nowhere, fully formed. Second, there is mutual dependence between parts and the whole; without parts there can be no whole, without a whole it makes no sense to speak of parts. This interdependence of parts and the whole applies in both spatial and temporal terms. Third, anything that exists and has an identity does so only within the total network of everything that has a possible or potential relation to it. No phenomenon exists with an independent or intrinsic identity.

And the world is made up of a network of complex interrelations. We cannot speak of the reality of a discrete entity outside the context of its range of interrelations with its environment and other phenomena, including language, concepts, and other conventions. Thus, there are no subjects without the objects by which they are defined, there are no objects without subjects to apprehend them, there are no doers without things done. There is no chair without legs, a seat, a back, wood, nails, the floor on which it rests, the walls that define the room it's in, the people who constructed it, and the individuals who agree to call it a chair and recognize it as something to sit on. Not only is the existence of things and events utterly contingent but, according to this principle, their very identities are thoroughly dependent upon others.

Modern science has overturned its own foundations and now presents a picture of reality which is in accord with that proposed by Buddhist sages of two thousand years ago. The Madhyamika philosophers developed a rigorous and razor sharp method of philosophical analysis which, together with meditation investigation, penetrated into the ultimate nature of reality.

Emptiness, the core view which is propounded by the Madhyamaka, is the insight that there is nothing in the universe which exists as an independent entity in its own right. It follows that nothing exists as a fully independent feature of reality as was always thought by Western science up until the advent of quantum physics. Indeed, an understanding of Emptiness can throw new perspectives onto problems of quantum interpretation.

The search for the ultimate TOE (a theory of everything) has become a central concern for modern physicists. But it is seldom appreciated that without integrating the phenomenon of consciousness within the 'physical' worldview any such TOE will not have a leg to stand on. This fact is unaviodable becuase consciousness is implicated at the quantum level. As the physicists Bruce Rosenblum and Fred Kuttner have recently indicated:

Consciousness and the quantum enigma are not just two mysteries; they are the two mysteries; first, our physical demonstration of the quantum enigma, faces us with the fundamental mystery of the objective world `out there` the second, conscious awareness, faces us with the fundamental mystery of the subjective, mental world `in here`. Quantum mechanics seems to connect the two.

An overview of a few significant attempts to produce a unified metaphysical account of the functioning of reality conceived of as a process of an ultimate quantum Mindnature. The quantum mind/consciousness perspectives covered are:

David Bohm's Implicate Order --
The visionary physicist suggests that dualistic mind and matter unfold from a unified Mindnature field.

Karl Pribram's Holonomic Brain --
The brain as holographic storage device in a holographic Mindnature universe.

David Chalmers --
The Quantum Solution to the 'Hard' Problem? -- An overview of Chalmer's analysis indicates that quantum Mindnature monism is an easy way to solve the 'hard' problem.

Max Velmans --
Dual Aspect Information Theory and Reflexive Monism Deep reflection on 'Reflexive Monism' shows that information is all in the Mindnature.

Penrose/Hameroff --
The Orch OR of Fundamental SpaceTime -- A Mindnature orchestration of Orchestrated Objective--Reduction gets to the bottom of the 'matter' of funda--mental spacetime.

Henry Stapp's Mindful Universe and the Psycho--Physical Bridge --
There's no place for Descartes' 'matter' in a quantum Mindnature universe.

Amit Goswami --
Scientific Proof of the Existence of God? -- God as the ultimate personification of the quantum Mindnature of the Universe?

QUANTUM EPIONTIC MIND MATRIX
Beginning with an overview of Nobel Laureate Frank Wilczek's notion of the 'Grid', which is the 'Matrix' that constitutes the 'primary ingredient' of reality, we note that he has, in his haste to get to grips with the 'material' of reality, become unconscious of consciousness. Therefore we reinstall this much more 'primary ingredient' with the help of, firstly, the Buddhist Dzogchen (Great Perfection) version of the Universal Matrix of Mindnature which indicates the ultimate nature to be 'emptiness and cognizance, and also the recent quantum 'epiontic' paradigm, which indicates, in conformity with the Dzogchen view, that cognition (epistemological activity) solidifies ontology.

chitti kasemkitvatana

At the centre of Chitti Kasemkitvatana's work stands a concept of emptiness, of the presence of the absent/absence with particular focus on its permeability. The Thai artists draws no distinctions, either between various positions in the art world, or between art and everything else, spirituality for instance. Following an active period in the Bangkok art scene during the 1990s Kasemkitvatana lived in a forest monastery in the north of Thailand from 2002 and 2010.

Then, as today -- before and after his time in the monastery -- Kasemkitvatana propagates a radically expanded concept of art, as social practice above all, a sphere of enabling, a domain of encounter, a network and free space. Artistic, curatorial and publishing work all have an equal footing within these parameters; the boundaries between spheres are fluid. At the turn of the millennium, for example, he worked with Rirkrit Tiravanija at Ver Magazine and curated exhibitions for the About Art Related Activities (AARA) project in About Cafe, one of the main art locations in the city at the time. Since 2012 he has been part of a group that runs Messy Project Space in Bangkok (and also publishes the Messy Sky Magazine with Pratchaya Phinthong).

In his own artistic work Kasemkitvatana also focuses on the moment in which various spheres become "porous". This also applies to his biography, where the interruption of his art career to spend time in a monastery should not be regarded as a retreat from art, nor his eventual return to the art world as a end to his preoccupation with spirituality. The various fields and periods are interwoven in a multitude of ways. Recent exhibitions such as Tomorrow Was Yesterday (2011) at the Jim Thompson foundation in Bangkok, assimilate old works from the 1990s, transforming them, paying respect to Kasemkitvatana's old teacher Aleks Danko, and incorporating experiences from the monastery.

His works and exhibitions return again and again to themes of emptiness and concentration: books with empty pages, elaborately folded paper fans, empty wooden boxes (as seen for example in the exhibition mo(nu)ment / [...] / memor(y)ial -- another transmission (2012) at gb agency/Leven One in Paris). As part of a performance performed 2012 in Paris for series no. 00 Kasemkitvatana attempted to transfer a coin into the Zone de Sensibilité Picturale Immaterielle proclaimed by Yves Klein at the same location 50 years earlier. The idea was to translate a piece of materiality into immateriality and thus render the void tangible.

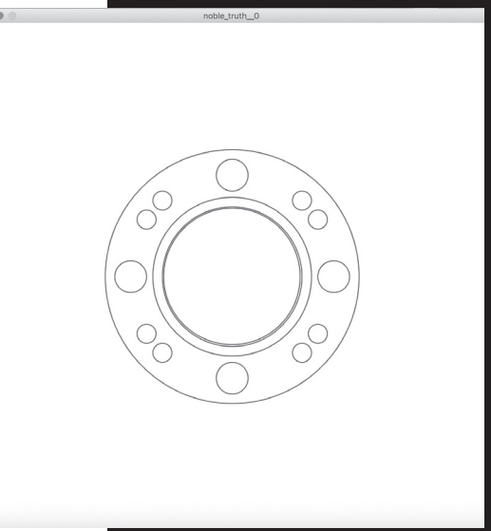
One moment into another. A collision.
Photographer: Jens Ziehe

One moment into another. A collision.
Photographer: Jens Ziehe

discussion with experimentation

IS CODING THE NEW SECOND LANGUAGE?

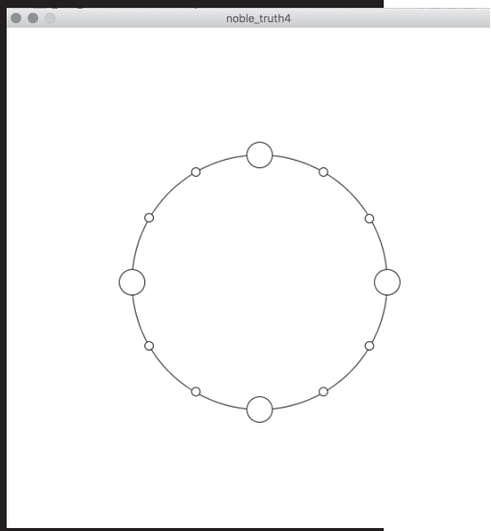
People may know their way around a computer, but in order to get a job in the new economy, they will have to know how to write a program, not just use one.... Within the context of geometry--driven form giving, this experimental aims to provide an understanding of how geometric design principles influence me to practice in developing forms by using javascript. First and foremost, a definition of form--giving will be given with respect to geometry. This is followed up by a study of most used geometric design principles. In coding culture class, I used the idea of making forms by mathematics that is an essential tool in communication or language interpretation to draw the forms that show the idea of thinking of buddhist.

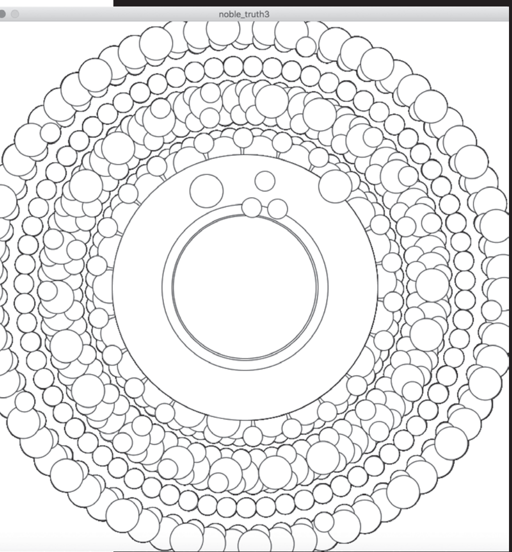



```
// i have to draw a circle
// i need a variable to store the actual angle
float angle;

void setup(){
  //window and background
    // window size
    size (800,800) ;
    //background in white
    background (255,255,255);

    angle=0;
}


void draw(){

  // draw a circle
    ellipse (400,400,400,400); // position x, position y,
size of circle

    // draw 2nd circle
    ellipse (400,400,250,250);
    // draw 3rd circle
    ellipse (400,400,220,220);
    //draw 4th circle
    ellipse (400,400,215,215);


    translate(400,400);
    rotate(angle);
    // draw small circle around big circle
    ellipse (90,80,30,30);
    ellipse (200,40,50,50);
    ellipse (90,320,30,30);
    ellipse (200,360,50,50);
    ellipse (310,320,30,30);
    ellipse (210,80,30,30);
    ellipse (40,200,50,50);
    ellipse (260,200,50,50);
    ellipse (65,110,30,30);
    ellipse (65,290,30,30);
    ellipse (335,110,30,30);
    ellipse (335,290,30,30);
    rotate(-angle);
     translate(-400,-400);

    angle = angle + 10;

}
```



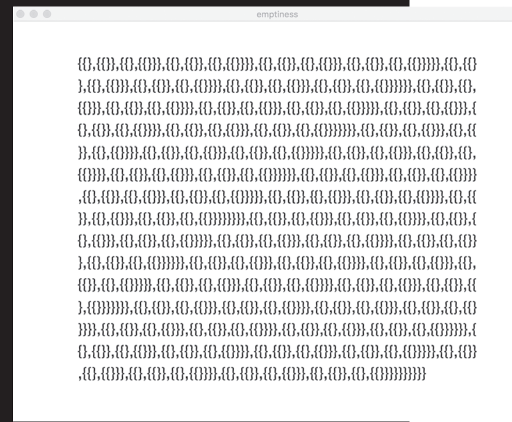
```
void setup(){
  size(600,600);

}



void draw(){
  // backround white
  background(255);

  // draw the main circle
  ellipse(300,300, 300,300);

  // draw a serie of circles
  int numberOfCircles=12;
  float angle=2*PI/numberOfCircles;


  // repeat
  for(int i=0;i<numberOfCircles;i++){
    float x= 300 + 150*cos(angle*i); // calculus of x
    float y= 300 + 150*sin(angle*i); // calculus of x
    // condition to the width
    if (i%3==0){
      ellipse(x,y,30,30);
    }else{
      ellipse(x,y,10,10);
    }


  }

}
```






```
// i have to draw a circle
// i need a variable to store the actual angle
float angle;

void setup(){
  //window and background
    // window size
    size (800,800) ;
    //background in white
    background (255,255,255);

    angle=0;
}


void draw(){

  // draw a circle
    ellipse (400,400,400,400); // position x, position y,
size of circle

    // draw 2nd circle
    ellipse (400,400,250,250);
    // draw 3rd circle
    ellipse (400,400,220,220);
    //draw 4th circle
    ellipse (400,400,215,215);


    translate(400,400);
    rotate(angle);
    // draw small circle around big circle
    ellipse (90,80,30,30);
    ellipse (150,40,50,50);
    ellipse (90,320,30,30);
    ellipse (150,360,50,50);
    ellipse (110,120,30,30);
    ellipse (210,80,30,30);
    ellipse (40,200,50,50);
    ellipse (200,200,50,50);
    ellipse (65,110,30,30);
    ellipse (65,290,30,30);
    ellipse (235,110,30,30);
    ellipse (235,290,30,30);
    rotate(-angle);
     translate(-400,-400);

    angle = angle + 10;

}
```

```
String theText="";

// at start
void setup(){
  size(800,600);
  textSize(21.5);
}



void draw(){
  background(255);// white
  fill(0,0,0);
  //template and grid
  //String theText="sdfsfsdf";
  text(theText,100,50,600,500);
}

// keypressed ?
// interact with typing keyboard
void keyPressed(){

  int thenumber=int(key);
  String[] listStrings = new String[10];
  String calculatedText;

  for(int j=0;j<10;j++){
    listStrings[j] = "{}";
  }



  if ((thenumber>=48) && (thenumber<=57)){
    theText = "the number is : "+key;

    int therealnumber = thenumber--48;

    for(int i=0;i<=therealnumber;i++){
      calculatedText="";
      for(int k=0; k<i; k++){
        if (k==0){
        }else{
          calculatedText=calculatedText+",";
        }
        calculatedText = calculatedText+listStrings[k];
      }
      listStrings[i]="{"+calculatedText+"}";
    }
    theText = "the therealnumber is : "+therealnumber;
    println(listStrings);
    theText = listStrings[therealnumber];
  }else{
    theText = "it is not a number : "+key;
  }
  //println(thenumber);
}
```



conclusion;

Somewhat parallel problems arose in Buddhist philosophy in relation to the disparity between our commonsense view of the world and the perspective suggested by Nagarjuna's philosophy of emptiness. Nagarjuna invoked the notion of two truths, the "conventional" and the "ultimate," relating respectively to the everyday world of experience and to things and events in their ultimate mode of being, that is, on the level of emptiness. On the conventional level, we can speak of a pluralistic world of things and events with distinct identities and causation. This is the realm where we can also expect the laws of cause and effect, and the laws of logic such as the principles of identity, contradiction, and the law of the excluded middle--to operate without violation. This world of empirical experience is not an illusion, nor is it unreal. It is real in that we experience it. A grain of barley does produce a barley sprout, which can eventually yield a barley crop. Taking a poison can cause one's death and, similarly, taking a medication can cure an illness. However, from the perspective of the ultimate truth, things and events do not possess discrete, independent realities. Their ultimate ontological status is "empty" in that nothing possesses any kind of essence or intrinsic being.

The paradoxical nature of reality revealed in both the Buddhist philosophy of emptiness and modern physics represents a profound challenge to the limits of human knowledge. The essence of the problem is epistemological: How do we conceptualize and understand reality coherently? Not only have Buddhist philosophers of emptiness developed an entire understanding of the world based on the rejection of the deeply ingrained temptation to treat reality as if it were composed of intrinsically real objective entities but they have also striven to live these insights in their day--to--day lives. The Buddhist solution to this seeming epistemological contradiction involves understanding reality in terms of the theory of two truths. Physics needs to develop an epistemology that will help resolve the seemingly unbridgeable gulf between the picture of reality in classical physics and everyday experience and that in their quantum mechanics counterpart. As for what an application of the two truths in physics might look like, I simply have no idea.

At its root, the philosophical problem confronting physics in the wake of quantum mechanics is whether the very notion of reality--defined in terms of essentially real constituents of matter--is tenable. What the Buddhist philosophy of emptiness can offer is a coherent model of understanding reality that is non--essentialist. Whether this could prove useful only time will tell.

```
/*
Somewhat parallel problems arose in Buddhist philosophy in rela-
tion to the disparity between our commonsense view of the world
and the perspective suggested by Nagarjuna’s philosophy of empti-
ness.
*/

function TheSeries0fFORMSinBUDDHISM(theSIZE) {


// Maybe find the boundary of this étude
// But can we really understand buddhism only by forms?
size (000,000) ;
// It also depends on people understanding about life and world.
background (255,255,255);
// Thinking about idea and believe in buddhism
// Buddhism use circle to represent the religion
ellipse (000,000,000,000);
if (i>=0,1) {
Happiness = “understanding world.” (What should I explain.)
}
// Everything is getting complicated.{
for (var i=0, E=nhf, ) ------
}
// 0 = happens 1 = not happens

// Here are some other philosophers.
Mostly they have the same idea of human being.

WesternPhilosopher = [“since before history”, “Menander
(such a first people who can be the evidence that buddhism is log-
ic!)” ,

“Einstein”, “Immanuel Kant”, “Mathieu Ricard”, “Hellenistic”,
“Edward Conze”, “David Hume”, “Authur Schopenhauer”, “Friedrich
Nietzsche” , “Graham Parkes”, “Reinhard May”, “Jean Paul Sartre”,
“Merleau--Ponty”, “Alfred North Whitehead”, “Ludwig Wittgenstein”
, “Arthur Schopenhauer” ] /**/
```



```
// Another Reference
// Movie
// The Matrix is also the movie that has the same idea with bud-
dhism

“The Matrix” = [“Such observations would seem to make it
relatively easy to characterize The Matrix as a Buddhist film;
however, things aren’t nearly so simple as they appear.
For one thing, it isn’t a universal belief among Buddhists
that our world is only an illusion. Many Mahayana Buddhists argue
that the world really exists, but our understanding of
the world is illusory -- in other words, our perceptions of
reality do not entirely match what reality actually is.”]

[“In addition, the simple identification of the Matrix as the “en-
emy,” along with the Agents and other programs who work on behalf
of the Matrix, is a bit contrary to Buddhism. Christianity may
allow for a dualism that separates good and evil, but that doesn’t
really play so much of a role in Buddhism because the real “enemy”
is our own ignorance. Indeed, Buddhism would probably require that
sentient programs like the Agents be treated with the same compas-
sion and consideration as sentient humans because they, too, need
to be liberated from illusion.”]

// Wow, Lots of things to read.
words = ‘ ‘ ; wordless = ‘ ‘ ;
// I am calm. I am calm.

function meditation (calm) {
// Meditation ? consciousness (void) : end();
}

// Idea point (the main idea of this étude) {
if (VOID = EMPTINESS) { return 1; }

for Emptiness {
(quantity === 0,1);
}
```

}
(i>0) {
number = 1
(suffering = the existence of suffering? Birth and
death are suffering. Grief and anger. Envy and fear of anxiety and
disappointment are sharply separated from the sufferings of
love is also suffering. The hate is suffering.
Just a solid hold on the feelings of all 5 distressed Khan.)

number = 2
(accumulation of awicha = suffering because of the reasons.
People can’t see the truth of life. They fall into the flames of
passion Rage. The envy Grief, fear, anxiety, and disappointment.)

number = 3
(Complete extinction = your misery. Understanding the truth of
life,
leading to the sad message level. Sok an also States contributing
to
peace and delight.)
} and {

number = 4
(The four noble truths = the path leading up to the level of dis-
tress:
ariyamak 8, which has been nurtured by a well--informed
life has consciousness, leading to meditation and wisdom that
will liberate? Delight Therefore God mercy us navigation along
the way of this knowledge.)

}

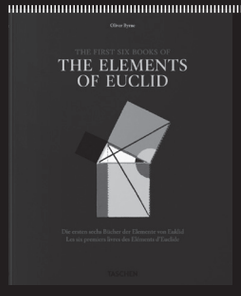
// Buddhist Emptiness is a philosophical conclusion,
not a ‘thing’, state or attribute. The Emptiness of phenomena
should not be confused with the delusion of a self--existent void.

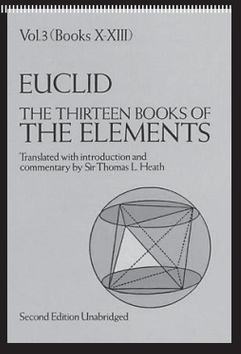
// Emptiness is the logical conclusion of the unfindability of
a ‘thing in itself’ once every cause and component that is ‘not
the thing’ has been removed from its basis of imputation.
Buddhist Emptiness always re-- fers to an object whose
‘inherent existence’ has been refuted, for exam-- ple
the emptiness of a chariot. Emptiness too is empty,
and Nagarjuna warned against reifying it.

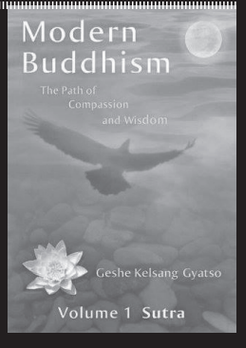
// Buddha is just a human who can find the way to get out of the
world of suffering and teach how to live in this suffering world.

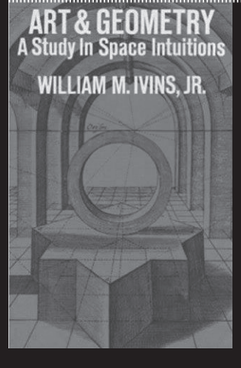
function end() {
// All proved
// any doubt ?
// couldn’t doubt more …
// Boundary is time.
// there will be lots of things to learn more…
return void this, words;
}

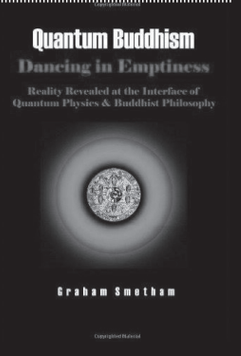
bibliography;











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thank you;

BOOK AND PROJECT ||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||
curated and text : kittitorn kasemkitwatana
graphic designer : nattapol rojjanarattanangkool
programmer : parkpoom wannachai
project adviser : simon henin

THANKFUL ||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||
chitti kasemkitvatana
simon henin
sarngsan na soontorn
armand behar
kate grudpan
supara grudpan
siraprapa wattanakul
sylvie tissot
didier gugole
nipan oranniwesna
kasemkitwatana family
and my friends

PLACES ||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||
ensci-les ateliers
center of excellence on innovation in
analytical science and technology, chiang mai university
datapaulette
la paillasse
materio

about
kittitorn kasemkitwatana;

EDUCATION ||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||

• Master in design and contemporary technology
École nationale supérieure de création industrielle
(november 2015 - 2016)
// Studies
• Fashion design at Studio Bercot
(september 2014 - february 2015)
// Certificate at The International Art Center, Alliance Francaise de Bangkok
(april 2013 - september 2013)
• Le cour d'ensignement Superieur de patronage et montage
(july 2013 - december 2013)
• Moulage
// Bachelor degree
Faculty of Decorative Art, Silpakorn University
Textile Arts, Applied Art Study
(2008 - 2012)

EXPERIENCE |||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||

conference
// science and design in contemporary world
at Center of Excellence for Innovation in Analytical Science and Technology,-
Chiangmai University
(30 july 2016)
• KATI production
// co-founder (Creative Concept)
(june 2016 - present)
• SODA
// designer (Art direction, Textile design)
(May 2012 - September 2013)
• munchu's
// Freelance Graphic Designer
for AW 2012 collection “SPY EYE”
Project collaboration Munchu's X Foremost
• Q Design & Play
// Freelance Designer
(2010)
for AW 2010 collection
• Jim Thompson Art Center
// Trainee (March - May 2011)
Artist Assistance for the exhbition “Tomorrow was Yesterday”
by Chitti Kasemkitvatana
// Bag's pattern making