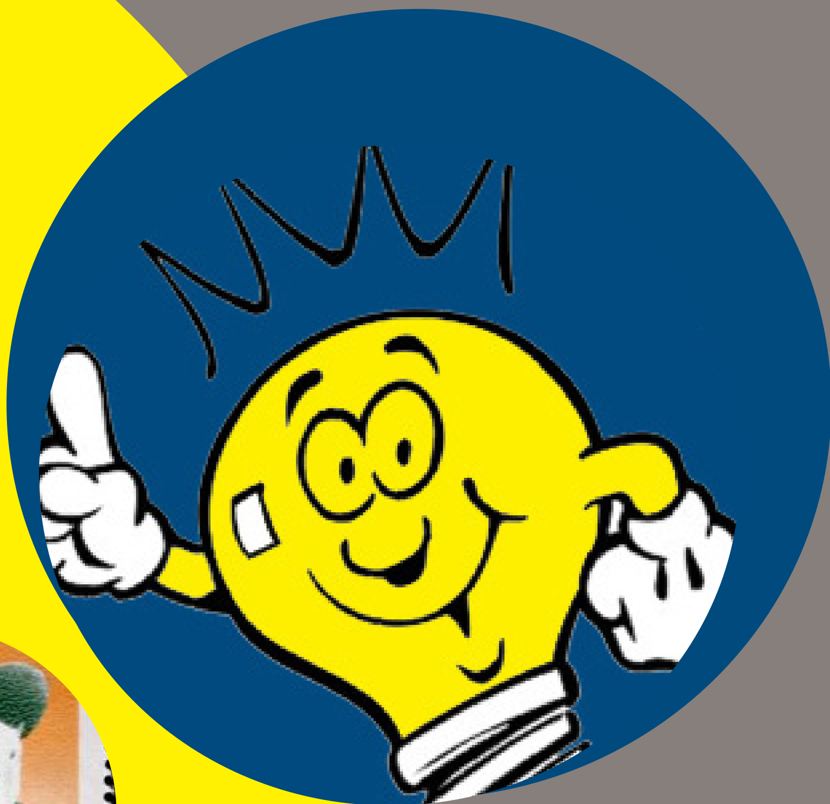
EP *Magazine*

History of Science and Technology



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EN- Editorial

THE CANCER AND A POSSIBLE CURE

At the present, the main responsible of the death of many people is a pathology called cancer. Already everybody knows it, and statistically a third of people suffer from it, even in the 99% of cases they do not know what it is.

In our body, there are many totipotential cells, which are not-specialized ones; sometimes, for unknown reasons, they could quickly reproduce themselves shaping a tumor. When it sends messenger proteins that flow in the blood, succeeds in affecting to other organs and "infect" them. Now it turns from a tumor to a cancer, which causes metastasis. Correlated to this, there is the chemotherapy, a cure that is carried out through the administration of medicines that should kill the silk cell but really kill also the healthy cells that reproduces themselves quickly (like liver). Per instance, during this therapy one lose hair. Despite this, the chemotherapy is a "cure" that gives its results. If even this fails to heal the patient, the doctors could sometimes provide radiotherapy, which uses the radiations (X rays, gamma rays) that emit special types of radiation that kill the silk cells. These radiations can be administered by radioactive means (like a radio-metabolic therapy made by radioactive iodine) or administrating the radiation from outside the body with an apparatus that surrounds the patient. However, if the cancer is discovered too late, when the disease is very advanced, we cannot do too much else, because the time of treatment is very long. Could we talk about stem cells as a cure for cancer? Would it be a method to ensure security to people? Stem cells are undifferentiated cells that, genetically modified, can destroy the cancer, in theory we can take a cancer cell, study and understand the types of antibodies that turn up to respond positively, then we can stimulate cells to produce the specific antibody, and introduce this in the body of the patient just killing the cancer cells. This is a theory, only, which has not been confirmed so far. Nowadays

IT- Editorial

IL CANCRO E UNA POSSIBILE CURA

In questo periodo una delle cause maggiori che provocano la morte è una delle malattie più letali al mondo, il cancro. Ormai tutti la conoscono, e statisticamente una persona su tre ne soffre, anche se nel 99% dei casi non si conosce il vero motivo del male. Nel nostro corpo ci sono moltissime cellule totipotenti cioè la proprietà di una singola cellula staminale animale di svilupparsi in un intero organismo e persino in tessuti extra-embrionali.

Un esempio di cellula totipotente è il blastomero (in embriologia, ciascuna delle cellule che risultano dalla segmentazione dell'uovo fecondato); Il cancro inizia con l'attivazione di un oncogène (la cellula che, in seguito a delle mutazioni, come il mancato controllo della proliferazione cellulare, diventa una cellula tumorale) in grado di determinare la divisione insolitamente frequente di cellule che formano il rivestimento della parete corporea colpita. Ulteriori mutazioni del DNA causano, in seguito, lo sviluppo di un piccolo tumore benigno. Altre mutazioni portano infine all'acquisizione della capacità di migrare in altri tessuti da parte delle cellule tumorali e quindi alla formazione di un tumore maligno (carcinoma). A questo punto non si parla più di tumore ma di cancro che presenta delle metastasi.

Correlato a ciò, vi è la possibile cura: la chemioterapia, che prevede la somministrazione di farmaci i quali dovrebbero uccidere le cellule malate ma che, in realtà, uccidono anche le cellule del corpo che si duplicano molto velocemente (come il fegato); tra i possibili effetti collaterali della chemioterapia è molto probabile la caduta dei capelli e altri possibili disturbi, ma ciononostante rimane una "cura" che dà risultati percepibili. Se nemmeno questa riesce a guarire il paziente, si può ricorrere alla radioterapia, che usa le radiazioni di raggi X, raggi gamma o altre, emesse da particolari tipi di particelle radioattive che possono portare alla morte di quelle malate. Queste radiazioni possono essere somministhere are not appropriate instruments, yet, and scientists are studying to make this theory a real fact; anyway, it seems to be science fiction.

Obviously, in the future it might become truth; in fact, the present kinds of therapy are the fruit of research and studies by many people that have collaborated to develop an effective cure. During the years, fortunately, we have discovered cures that reduces the cancer mortality rate, but in the past, this was a theory either. For these reasons, it is normal to consider the stem cell possibility as science fiction, but it will not

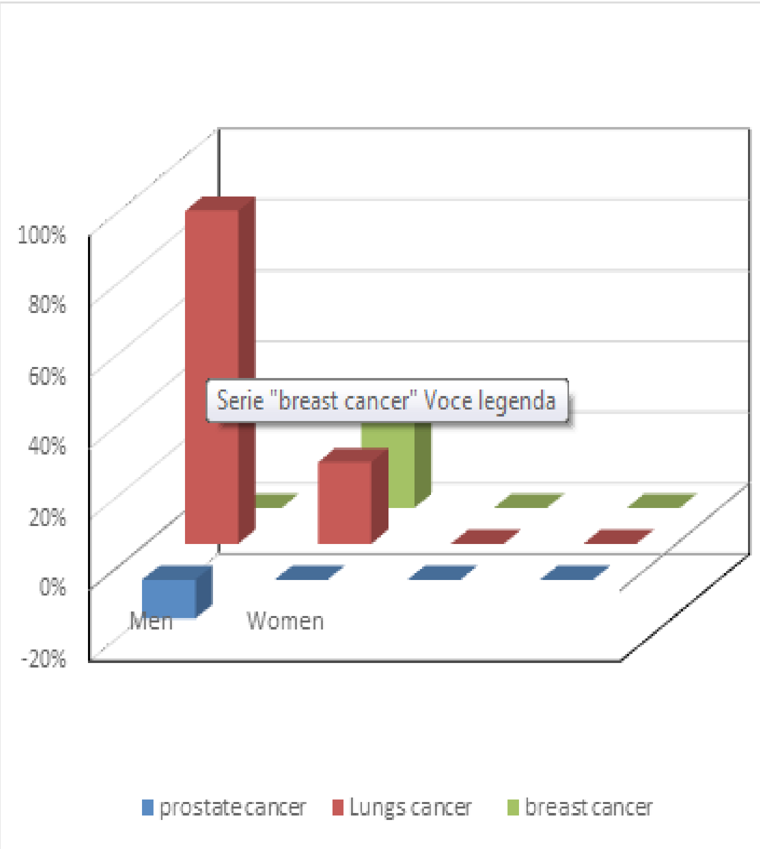


Fig. 1. **Tumoral incidence male and female**
Made by the author
Fig. 1. Incidenza tumorale maschile e femminile
(Grafico elaborato dall'autore)

trate attraverso farmaci (come la terapia radiometabolica fatta con lo iodio radioattivo per distruggere il tumore alla tiroide, che si utilizza in maniera specifica lo Iodio) oppure mediante una dose di raggi al corpo del paziente attraverso uno specifico macchinario. Se il cancro, invece, viene diagnosticato troppo tardi, nel momento in cui è già molto avanzato, non ci si può fare molto poiché il tempo che si impiegherebbe ad eliminare le cellule malate sarebbe troppo lungo.

Si potrebbe provare attraverso le cellule staminali (cellule primitive, non differenziate, dotate della capacità di trasformarsi in diversi altri tipi di cellule del corpo attraverso un processo denominato differenziamento cellulare) una possibile cura, la quale porterebbe ad un metodo per garantire forse un po' più di sicurezza alla gente malata.

Le cellule staminali sono cellule che, modificate geneticamente, potrebbero distruggere il cancro dall'interno. In teoria si potrebbe prendere una cellula tumorale, studiarla e capire a quali tipi di anticorpi risponde positivamente; successivamente, si potrebbe indurre la cellula staminale a produrre il particolare anticorpo, introdurlo nel corpo del paziente e uccidere in questa maniera le cellule tumorali/cancerogene. Tutto ciò però è solo una teoria che ancora non è stata né confermata né provata. Non ci sono ancora gli strumenti adatti e si sta studiando ancora molto per rendere questa teoria una verità.

Potremmo considerare fantascienza questa opportunità?

Sicuramente in futuro potrà diventare una realtà: infatti, tutto ciò che noi abbiamo ora è il frutto di lavori, studi, scoperte non di una persona, ma di molte che hanno collaborato per dare a noi cure effettive.

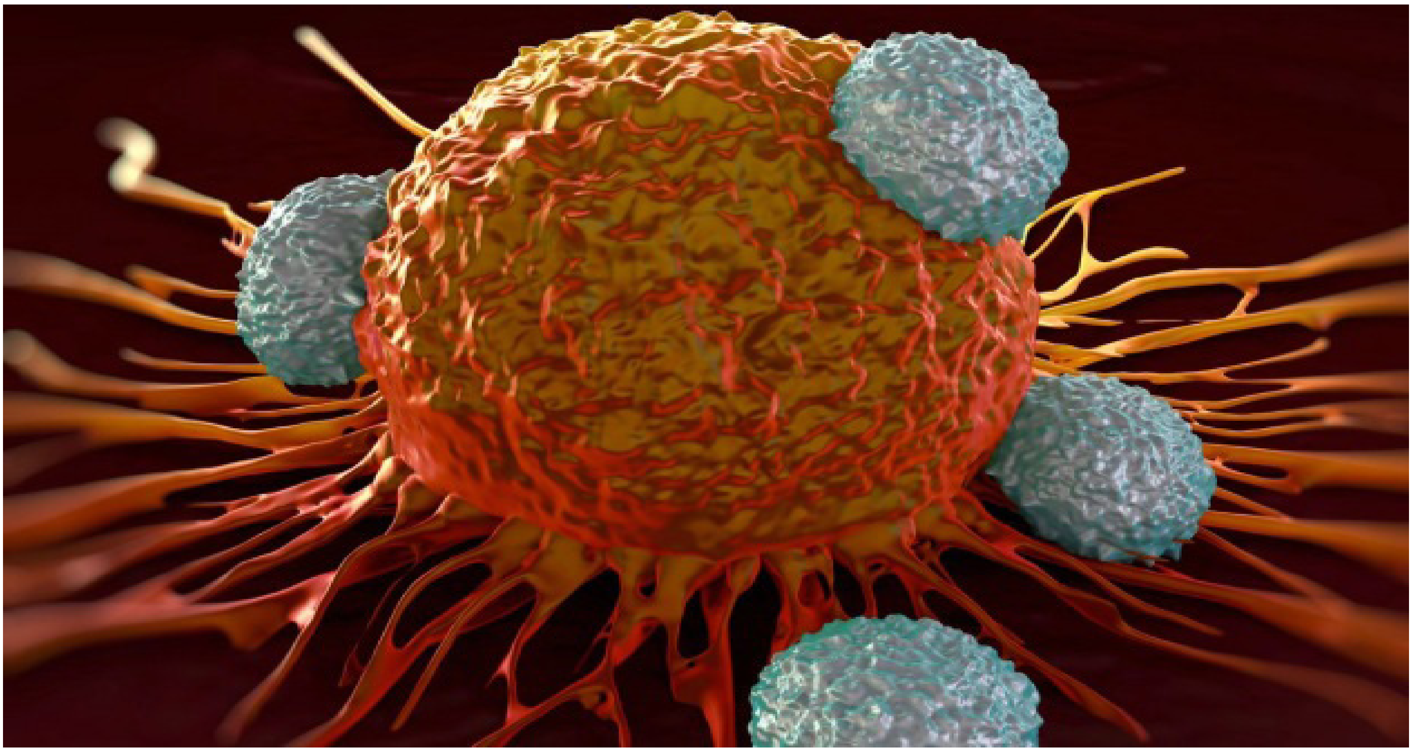
Nel corso degli anni queste teorie sono diventate pratica e adesso fortunatamente abbiamo qualcosa che realmente diminuisce la mortalità tumorale. In precedenza, anche queste erano solo teorie fantascientifiche ed è normale. per i tempi nostri considerare le cellule staminali utilizzate per curare questa malattia come fantascienza ma non sarà per sempre così; la scienza fa il suo corso e tutto può cambiare e, ovviamente, migliorare.

be the same because we know that science changes and always develop almost quickly.

We strongly wish, and it could be possible, that in a not far future an EP*Magazine* young reader shall come to an incredible solution and the last discoveries that we have nowdays, like an effective chemotherapy, will look like pure history.

Ci auguriamo - ed è possibile - che in un non lontano futuro un giovane lettore di EP*Magazine* possa arrivare a soluzioni stupefacenti, tali che le apprezzabili cure di oggigiorno come la chemioterapia sembreranno banali.

Un saluto da un'alunna che spera, davvero con tutto il cuore, di diventare un ottimo dottore.



BG- Editorial

РАКЪТ И ВЪЗМОЖНОТО МУ ЛЕЧЕНИЕ

Понастоящем основната причина за смъртта на много хора е патологията, наречена рак. Вече всички го знаят и статистически една трета от хората страдат от него, но в 99% от случаите те не знаят какво е то.

В нашето тяло има много тотипотентни клетки, които са неспециализирани клетки. Те, по неизвестни причини, се възпроизвеждат, оформяйки тумор. Когато изпраща пратeлените протеини, които кръстосват, кръвта успява да стигне до другите органи и да ги зарази. Сега тя вече представлява не само тумор, а рак, който има метастази. Свързано с това е химиотерапията - терапия, която се извършва чрез администриране на лекарства, които трябва да убиват раковата клетка, но наистина убиват и клетката, която се възпроизвежда бързо, всъщност по време на тази терапия може да ви окапе косата, въпреки че химиотерапията е "лечение", което дава резултати. Ако дори това не успее да излекува пациента, лекарят може да прибегне до лъчетерапия, която използва излъчванията на рентгенови лъчи, гама лъчи, които отделят специални видове радиоактивност, които убиват раковата клетка.

Тези лъчения могат да се прилагат с радиоактивни медикаменти (като радиообменна терапия, направена с радиоактивен йод, за да се намали щитовидната жлеза) или да се приложи облъчване отвън на тялото с машина, която обгражда пациента. Въпреки това, ако ракът се открие твърде късно, когато болестта е много напреднала, не можем да направим много, защото времето на лечение е много дълго.

Можем ли да говорим за стволови клетки, за да намерим лек за рак? Би ли бил метод

GR- Editorial

Ο ΚΑΡΚΙΝΟΣ ΚΑΙ ΜΙΑ ΠΙΘΑΝΗ ΘΕΡΑΠΕΙΑ

Στην εποχή μας, η κύρια αιτία θανάτου αρκετών ανθρώπων είναι μία ασθένεια που ονομάζεται καρκίνος, κάτι που το γνωρίζουν οι περισσότεροι. Στατιστικά, οι περισσότεροι πάσχοντες δεν γνωρίζουν περί τίνος ακριβώς πρόκειται. Στο σώμα μας υπάρχουν αρκετά πολυδύναμα κύτταρα, τα οποία είναι μη διαφοροποιημένα κύτταρα. Αυτά για άγνωστους λόγους αναπαράγονται σχηματίζοντας έναν όγκο. Οι πρωτεΐνες αγγελιαφόροι μέσω του αίματος φτάνουν σε διάφορα όργανα του σώματος και τα μολύνουν. Τότε δεν είναι πλέον όγκος, αλλά καρκίνος ο οποίος παρουσιάζει μετάσταση. Για την αντιμετώπισή της χρησιμοποιείται η χημειοθεραπεία, μία θεραπεία η οποία συνίσταται στην χρήση κυτταροστατικών φαρμάκων τα οποία μπορούν να σκοτώσουν τα μολυσμένα κύτταρα, αλλά σκοτώνουν επίσης και κάθε κύτταρο που αναπαράγει γρήγορα τον εαυτό του, έχοντας πολλαπλές παρενέργειες, όπως την πτώση των μαλλιών. Παρ' όλα αυτά η χημειοθεραπεία είναι μία αγωγή που δίνει αποτελέσματα. Αν και αυτή η θεραπεία του ασθενούς αποτύχει, ο γιατρός μπορεί να καταφύγει στην ακτινοθεραπεία με ακτίνες Χ και γ, οι οποίες σκοτώνουν τα μολυσμένα κύτταρα. Αυτές οι ακτινοβολίες μπορούν να χορηγηθούν με τη βοήθεια ραδιενεργών φαρμάκων (όπως μία ακτινοθεραπεία που γίνεται με ραδιενεργό ιώδιο για να καταπολεμήσει τον καρκίνο του θυρεοειδούς) ή να χορηγηθεί ακτινοβολία εξωτερικά με μία συσκευή που περιβάλλει τον ασθενή. Όμως, αν ο καρκίνος ανακαλυφθεί πολύ αργά, δηλαδή όταν έχει προχωρήσει πολύ, τότε δεν μπορούμε να κάνουμε πολλά πράγματα.

Θα μπορούσαμε να χρησιμοποιήσουμε τα βλαστοκύτταρα για να βρεθεί θεραπεία του καρκίνου; Θα ήταν μία μέθοδος που εμπνέει σιγουριά στους ανθρώπους; Τα βλαστοκύτταρα είναι μη διαφοροποιημένα κύτταρα, τα οποία όταν είναι γενετικά τροποποιημένα μπορούν за осигуряване на сигурност за хората? Стволовите клетки са недиференцирани клетки, които генетично модифицирани могат да унищожат рака, на теория можем да вземем ракова клетка, можем да проучим и разберем видовете антитела, които реагират положително, тогава ние можем да стимулираме клетката да произведе конкретно антитяло и да въведем това в тялото на пациента, за да убиват раковите клетки. Това е само една теория, която досега не е потвърдена, не съществуват подходящи инструменти и учените изучават, за да превърнат тази теория в истински факт, но дали в този случай е научна фантастика?

Очевидно е, че в бъдеще може да се превърне в истина, всъщност това, което в момента имаме е плод на произведения, изследвания, на много хора, които са си сътрудничили, за да ни дадат ефективно лечение. През годините за щастие открихме нещо, което намалява смъртността от ракови заболявания, но в миналото това беше и теория, поради което е нормално да се разглежда възможността за стволови клетки като научна фантастика, но няма да е същото, защото ние знаем, че науката се променя и винаги се подобрява. Вероятно в бъдеще ще стигнем до едно невероятно решение и фантастичното откритие, което сега имаме като химиотерапия, ще изглежда като чиста история.

να λειτουργήσουν σαν φυσιολογικά και να υποκαταστήσουν τη λειτουργία των καρκινικών. Θεωρητικά μπορούμε σε ένα καρκινικό κύτταρο να μελετήσουμε και να βρούμε τους τύπους των αντισωμάτων που ανταποκρίνονται θετικά στα καρκινικά αντιγόνα και έπειτα να διεγείρουμε το κύτταρο για να παράγει μονοκλωνικά αντισώματα. Στη συνέχεια να εισάγουμε τα μονοκλωνικά αντισώματα στο σώμα του ασθενούς και να σκοτώσουμε τα καρκινικά κύτταρα. Τα παραπάνω είναι μόνο μία θεωρία που δεν έχει ακόμη επιβεβαιωθεί. Δεν υπάρχουν ακόμη τα κατάλληλα όργανα και οι επιστήμονες μελετούν πώς θα κάνουν αυτήν τη θεωρία πραγματικότητα. Μήπως προς το παρόν είναι επιστημονική φαντασία; Προφανώς στο μέλλον θα γίνει πραγματικότητα. Προς το παρόν αυτά που έχουμε είναι οι καρποί εργασιών και μελετών αρκετών ανθρώπων που συνεργάσθηκαν για να μας δώσουν μια αποτελεσματική θεραπεία. Ευτυχώς στο πέρασμα του χρόνου ανακαλύψαμε τον τρόπο για να μειώσουμε τη θνησιμότητα εξαιτίας του καρκίνου, αν και αυτό σε παλιότερες εποχές δεν φαινόταν παρά μόνο μία θεωρία. Γι αυτούς τους λόγους είναι λογικό να θεωρούμε τώρα τη χρήση των βλαστοκυττάρων επιστημονική φαντασία. Αργότερα μάλλον δε θα είναι έτσι, δεδομένου ότι η επιστήμη προχωράει και προοδεύει. Πιθανόν στο μέλλον να φτάσουμε σε μία απίστευτη λύση και η εξαιρετική ανακάλυψη της χημειοθεραπείας, που έχουμε σήμερα, σύντομα να περάσει στην ιστορία.

Es- Editorial

En la actualidad, el principal responsable de la muerte de muchas personas es una patología llamada cáncer.

Todo el mundo ya lo conoce y estadísticamente un tercio de las personas lo padecen, pero en el 99% de los casos no saben lo que es. En nuestro cuerpo hay una gran cantidad de células totipotentes, que son células no especializadas; éstas, por razones desconocidas, se reproducen formando un tumor. Cuando envían proteínas mensajeras, navegan por la sangre y consiguen llegar a otros órganos e infectarlos. Si existe más de un tumor, el cáncer presenta metástasis.

Relacionado con esto está la quimioterapia, una terapia que se lleva a cabo mediante la administración de medicamentos que deben matar a la célula de seda pero realmente mata también a la célula que se reproduce rápidamente, de hecho, durante esta terapia se puede perder el pelo por completo, a pesar de ello, la quimioterapia es una “cura” que da sus resultados. Si incluso esto no funciona para curar al paciente, el médico puede recurrir a la radioterapia, que utiliza las radiaciones de rayos X, rayos gamma que emiten los tipos especiales de células radioactivas que matan la célula de seda.

Estas radiaciones se pueden administrar con medicamentos radioactivos (como una terapia metabólica de yodo radioactivo para destruir el tiroides) o administrar la radiación desde fuera del cuerpo con una máquina que rodea al paciente. Sin embargo, si el cáncer se descubre demasiado tarde, cuando la enfermedad está muy avanzada, no podemos hacer mucho porque el tiempo de tratamiento es muy largo.

¿Podríamos hablar de células madre para encontrar una cura del cáncer? ¿Sería un método para garantizar la seguridad a las personas?

Las células madre son células indiferenciadas que modificadas genéticamente pueden destruir el cáncer, en teoría podemos tomar una célula cancerígena, podemos estudiarla y comprender los tipos de anticuerpos que responden positivamente, entonces podemos estimular las células para producir el anticuerpo concreto e introducirlo en el cuerpo del paciente y matar a la célula cancerosa.

Esta es sólo una teoría que hasta ahora no ha sido confirmada, no existen los instrumentos adecuados y los científicos están estudiando para convertir esta teoría en un hecho real, pero en ese caso es ciencia ficción?

Obviamente, en el futuro puede convertirse en una realidad, de hecho, lo que de momento tenemos es el fruto de los trabajos, estudios, de muchas personas que han colaborado para darnos una cura efectiva.

Con el paso de los años, afortunadamente hemos descubierto algo que reduce la tasa de mortalidad del cáncer, pero en el pasado esto también era una teoría, por ello es normal que se considere la célula madre como ciencia ficción pero no es lo mismo porque sabemos que la ciencia cambia y siempre mejora.

Probablemente en el futuro habremos llegado a una solución increíble y el descubrimiento fantástico que tenemos ahora como quimioterapia, parecerá pura historia.

EPMagazine

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A Notable Bicentenary: Robert Stirling's Engine

Abstract

Robert Stirling's patent for what was essentially a new type of engine to create work from heat was submitted in 1816 and granted in 1817. Its reception was underwhelming and although the idea was sporadically developed, it was eclipsed by the steam engine and, later, the internal combustion engine. Today, though, the environmentally favourable credentials of the Stirling engine principles are driving a resurgence of interest, with modern designs using modern materials. These themes are woven through a historically based narrative that introduces Robert Stirling and his background, a description of his patent and the principles behind his engine, and discusses the now popular model Stirling engines readily available. These topical models, or alternatives made 'in house', form a good platform for investigating some of the thermodynamics governing the performance of engines in general.

1. Introduction

In late 1816 Robert Stirling applied for a patent that described heat exchangers and the technology of the Stirling engine. The Stirling engine is a markedly different machine from either the earlier steam engine or the later internal combustion engine. For reasons to be explained, after a comparatively obscure two centuries the Stirling engine is attracting new interest, for it has environmentally friendly credentials for an engine. This tribute introduces the man, his patent, the engine and how it is realised in example models readily available on the internet.

2. Robert Stirling

Robert Stirling was a Scottish farmer's son, born in 1790 in rural Perthshire, the third in what would become a family of 8 children that included 5 girls. It was an age when agricultural improvements by way of land reclamation and new machinery were in full swing in Britain. His grandfather, Michael Stirling, had invented an early rotary threshing machine driven by water power; his younger brother James Stirling (born in 1799) would make his name as an engineer and it is a fair bet that family interests in the new machinery of the age inspired the young Robert into becoming an amateur mechanic. It was said that the girls in the family were also mechanically talented[1]. The early 19th century was also an age when a farmer's son attending one of the East of Scotland's four universities was a commonplace occurrence. Authors disagree on the extent of Robert Stirling's formal education but records show that he enrolled in Edinburgh University in 1805 and took their courses for at least two years[2].

His second year included mathematics under the aegis of John Leslie, well-known for his study of heat[3] (Fig. 1). It is not clear if he was later taught Natural Philosophy by the notable and enthusiastic John Playfair who was also on the staff. If so, Playfair would have given Stirling a wide-ranging contemporary understanding of the principles behind the operation of many kinds of machine[4].

Robert Stirling (Fig. 2) would eventually have a long career as a Minister of the Church of Scotland, generally a graduate profession even two centuries ago. He spent additional time in divinity studies, certainly at Glasgow University and perhaps at Edinburgh too. Attendance records in both institutions were lax. Although he didn't formally collect the AM ('Artium Magister') degree that was expected for a career in the Church, he was ordained in 1816 as Minister for Kilmarnock. He was known to maintain a workshop and a continuing interest in machinery. Indeed, even later in his career "he sometimes surprised his neighbours at midnight by the hammering resounding from the anvil in his little smithy adjoining the manse "[5].

1816 is noted even now as the disastrous 'year without a summer' following the enormous eruption of Mount Tambora the previous year. Maybe the bad weather encouraged Stirling to spend even more time over the furnace in his smithy. Towards the end of 1816 he applied for his now famous patent[6]

(No. 4081) for an 'Economiser' that discussed various ways of exchanging heat. This was well before the time that heat was recognised as a transfer of internal energy between bodies. Heat was then considered as a substance in its own right – 'caloric' that could flow between bodies or simply evaporate as radiation, though Stirling himself never used the word in his patent description.

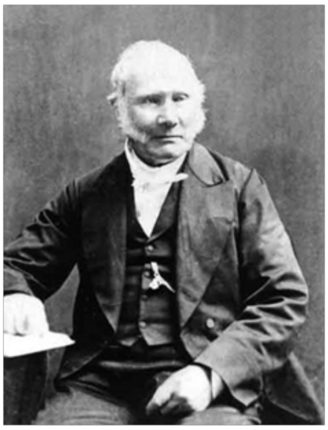


Fig. 2 **Robert Stirling was born almost 50 years before photography was invented. This is the only known image of him, in his later years**

3. The patent of 1816

Stirling's 1816 patent[7] began by describing a heat exchanger. He suggested that one version could consist of two parallel channels separated by a metallic plate. Hot fluid passed down one channel and cooled as it did so, passing its heat through the plate; cool fluid passed along the other channel in the opposite direction and was heated by the plate as it did so. It's quite surprising that the simple heat exchanger hadn't been patented before then. His simple arrangement was illustrated in the patent by Fig. 3. The next version described a furnace with

two flues. Air was blown in through one flue and the combustion gases expelled through the other, which of course heats up. The roles of the flues were then reversed so the air intake was now through the heated flue and the hot exhaust gases then heated up the other flue. This made the furnace more efficient since it was then fed with hot air and some of the exhaust gas heat was used - in modern language it was an exhaust heat recovery system. Stirling also added some practical points about implementing his principles. Having thought about recovering heat from flowing gases he went on to describe his engine.

We are all familiar now with the internal combustion engine using petrol, diesel, gas or some inflammable fuel. Such engines are a product of the second half of the 19th century, though the underlying concept had been thought of earlier. When the hot gas has done its work in the piston it is expelled as exhaust and the piston can move relatively unimpeded. The steam engine is an external combustion engine in which the working fluid, the steam, passes through the engine and is likewise exhausted.

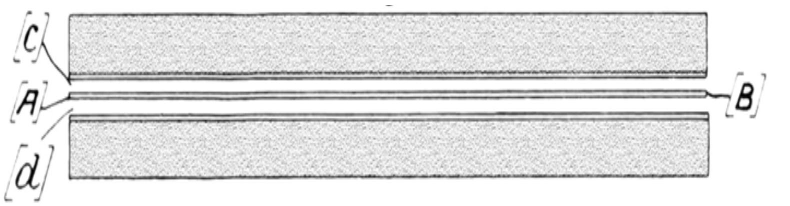


Fig. 3 **Diagram based on figure 2 of Stirling's patent, illustrating the basic heat exchanger. AB is the metal plate dividing two channels, C and D, through which fluids run in opposite directions.**

The Stirling engine was a radically new invention, different from either of these. It is an engine where the working gas is sealed in the piston and operates between a hot 'reservoir' and a cold reservoir. The hot end can be maintained by combustion but nowadays it can also be maintained by other means such as solar heating. Indeed, a single engine can be designed readily that is not limited to one particular fuel. The Stirling engine is also attracting a lot of attention these days because the external combustion can be optimised to produce minimum waste products like carbon monoxide and unwanted nitrous oxides: basically, cleaner emissions that minimise its environmental footprint.

So, how does the engine work? The 1816 version shows why the original idea was a development of heat exchanging. Fig. 4 shows the totally enclosed cylinder. The cylinder contains two independently moving parts: the tightly fitting power piston and a loosely fitting 'plunger'. The top of the cylinder is hot while the foot is cooled by air or water. The plunger is the heat exchanger. In Stirling's original concept the plunger was made of "sheet iron covered with thin plates of brass or silver to prevent the loss [of heat] by radiation" so it would quickly take in heat and give it out. When the bottom space is near its largest and coolest, the plunger comes down, moving air up its sides and reheating it due to the temperature gradient up its length. The air therefore arrives at the top needing less heat than it would do if just injected cold from outside. When the plunger rises it pushes hot air down its sides into the power space, in the process reheating the plunger. So during the cycle the plunger acts as a heat exchanger, without losing any energy to the outside. This action of Stirling's plunger he called 'regeneration'. I'm using the word 'heat' here as a synonym for thermal energy transferred without any accompanying work. The plunger has been likened to a heat sponge that alternately absorbs and releases thermal energy. Of course heat isn't a substance like water, but the analogy indicates that a good plunger is one with a large heat capacity that does not change its temperature much when absorbing or giving out energy as heat. A feature of Stirling's original design is that the power piston is separated from the furnace heat by the plunger. It is fed by hot gas but does not need piston rings that have to withstand cylinder walls at furnace temperature. Fig. 5 shows Stirling's engine as illustrated in his patent. The Stirling engine was improved from its 1816 incarnation by Robert and his brother James, who jointly submitted two subsequent patents. The 1827 patent (no. 5456) promoted a major development in that the power piston and 'plunger' were now designed to work in separate cylinders. This was the beginning of a wide range of variants which recognised that Stirling's original plunger did two jobs. It displaced air, or whatever gas is enclosed, between the two ends and it acted as a heat exchanger. These two jobs can be done separately by a 'displacer' and a 'regenerator' that may well be different components.

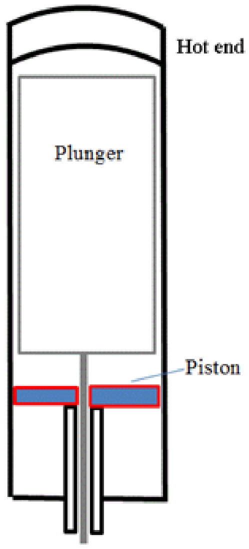


Fig. 4 *The Stirling engine cylinder, simplified from the drawing in the 1816 patent.*

Taken to extremes, the hot and cold ends can be in separate chambers connected by a tube. The displacer moves air between the tubes and the regenerator, if present in the tube, is the heat exchanger. Whatever the configuration, by moving the air within the engine the displacer maintains the cyclic motion of the engine, which isn't created simply by having steady hot and cold ends to a cylinder. In other engines the cycle is kept going by the engine's valves. Like valves, the displacer is generally driven by the power train. Stirling achieved this by connecting the plunger to the engine flywheel via levers.

The Stirling engine is not primarily about shunting energy around as heat but about producing work from the difference in temperature between hot and cold 'sources'. The modern view is that internal energy is disorganised energy, work done represents organised energy. Heat engines convert internal energy in hot sources into work, but not 100% efficiently. The underlying theory of en-

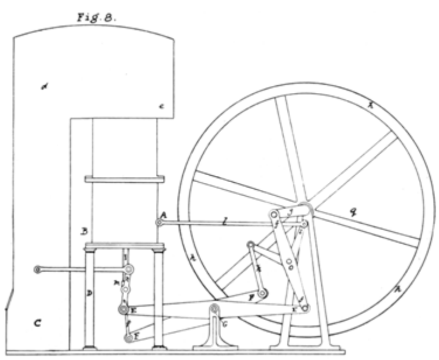


Fig. 5 **Stirling's engine as drawn in his patent of 1816 (republished in THE ENGINEER in 1917, ref. 6)..**

gine efficiency was developed by Sadi Carnot a decade or so after Stirling's first patent. Carnot recognised that an engine always heats up its coolant, thereby 'wasting' some of the initial heat energy. Carnot deduced that an engine's efficiency necessarily depends on the temperature difference between its hot gas and its cold gas. The bigger the difference, the more efficient an engine is in creating work from energy taken in as heat. This is equally true of the Stirling engine.

4. The indicator diagram

At the end of the 18th century, James Watt the famous steam engine developer had developed the indicator diagram to determine the amount of work done by an engine. This diagram is a plot of the cylinder pressure against the volume of the working substance. Watt devised a method of making the engine produce its own diagram automatically. A pressure gauge connected to the cylinder controlled the vertical movement of a pencil marking a sheet of paper and the cyclic motion of the piston, which is proportional to the volume, controlled the horizontal movement of the pencil. As the engine went through each cycle the pencil traced out a loop and the work supplied was proportional to the area within the loop. It was ingenious, and based on sound physics.

Fig. 6 shows the indicator diagram commonly quoted for an ideal Stirling engine. This diagram is a figment of textbooks. The perceptive J. Macquorn Rankine analysed the theory of thermodynamic engines in an extensive paper of 1854[8] in which he discussed the regenerator but he did not give a diagram for the Stirling engine. It appears that it was over 50 years after Stirling described his engine before the first theoretical analysis was given by Gustav Schmidt of the German Polytechnic Institute of Prague in 1871. Schmidt took the ideal cycle shown in Fig. 6, assumed sinusoidal variations of the volumes and an adjustable phase difference between the power piston and the regenerator. Even this analysis is not trivial[9] but when done the results don't represent accurately a real Stirling engine.

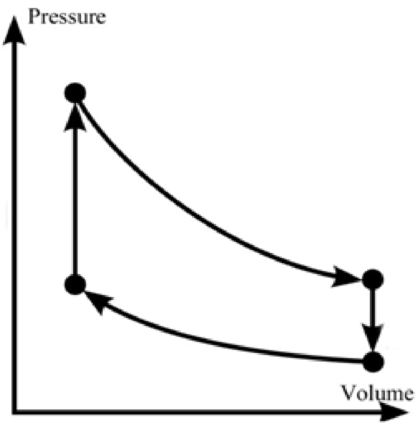


Fig. 6 **The indicator diagram for an ideal Stirling engine. The curved lines represent changes at constant temperature.**

The ideal cycle of the diagram is 'reversible' and therefore as efficient as an engine can be. The maximum efficiency of an engine is achieved by a 'Carnot engine', the one analysed by Sadi Carnot. Efficiency is this context is defined as the work provided by the engine divided by the heat extracted from the hot source. The ideal Stirling engine has the same efficiency as a Carnot engine working between the same temperature limits, though its changes in pressure and volume are different from the usually quoted 'Carnot Cycle'. The real Stirling engine involves forcing the gas within it rapidly through the narrow channels of a heat exchanger. This process involves friction and is never going to be reversible. Another problem with the Stirling engine is that all the gas inside isn't at the same temperature and pressure, making it more complex than a textbook idealisation. In real life Stirling engines usually can't manage half the efficiency of the ideal engine[10]. Robert Stirling didn't design his engine from any theory (there was no useful theory of engines in 1816): just an inspired idea supported by his own mechanical experience. Of course theory can be useful but the over-simplification of the Schmidt model rather distracts from what is happening in the real insides of a Stirling engine.

All that said, the indicator diagram is at least a raft in a sea of practical difficulties. Starting at the top left and going round clockwise, the power stroke is provided by the expansion of hot gas, during which heat is also taken in, ideally at constant temperature. The bottom line represents the compression of the cold gas, during which some heat is given out to the coolant, again ideally at constant temperature. This compression uses up some but not all of the work generated by the expansion and in practice is driven by the flywheel. The net result is that the work supplied by the engine is represented by the area within the diagram, as usual. The vertical sections are the least realistic parts, describing motion of the gas past the regenerator, ideally at constant volume.

One feature suggested by the ideal indicator diagram is that if the cylinder is filled with a gas at high pressure instead of the ordinary atmospheric pressure that Stirling himself described initially, then a change in pressure of say 60% during the cycle will result in a greater absolute change in pressure and hence more work will be done in each cycle. Modern Stirling engines favour the use of gas at high pressure. The Stirling engine may not live up to its 'theoretical' efficiency but with a high temperature provided by solar energy, the Stirling engine coupled to an alternator can still produce electricity with greater efficiency than a typical solar cell. This is one of the reasons Stirling engines are now being developed seriously.

With the indicator diagram still in view it is worth saying that when a Stirling cycle is driven in reverse (i.e. anticlockwise round the diagram) by an external motor, the engine acts as a heat pump or a refrigerator. Having no volatile refrigerant like ammonia or CFCs, it is environmentally clean and can operate at temperatures down to liquid nitrogen (about 200° C).

5. The patent of 1827

Robert and his brother James submitted a new patent in 1827 that described in considerable detail a substantial Stirling engine that had been built under James Stirling's guidance. This contained several important developments. First, they placed the displacer and power piston in separate cylinders, as mentioned. This has come to be known as the alpha (α) configuration. The 1816 geometry with displacer and piston in the same cylinder is the beta (β) version. They took a leaf out of James Watt's book and made the engine 'double acting', meaning that it produced power on both the upstroke and downstroke. Watt did this by valves; the Stirling's by arranging two displacers, one to feed the foot of the power cylinder and one the top of it. They inverted the design so that the hot ends of the displacers were underneath the machinery and they added a compressed air pump so the air within could be increased in pressure to around 20 atmospheres.

All these were very intelligent developments and if their design had been as good in practice as on paper then the Stirling engine could have been a serious competitor to steam. It was more efficient and hence more economical, and safer, an important point in an age when steam boiler explosions and engine failures were common. James Stirling's engine generated about 40 horsepower, enough to turn many machines in the foundry in Dundee that he managed.

It was James Stirling himself who found the big practical problem.

In the days before Bessemer's steel, the cast iron available for the air vessel could not take red heat for an extended period and burnt out. He was let down by the materials of the day. The Stirlings did submit a third patent in 1840 (no. 8652) with technical improvements but Bessemer steel was still in the future.

I should perhaps have said earlier that the description 'Stirling engine' is a 20th century name. In the 19th century the phrase 'hot-air engine' was used for both the Stirling engine and others of different designs that used hot air to push a piston and then expelled the air through a valve. The fact is, though, that you can look in a great many 19th century science and engineering books and find nothing about Stirling's engine, or other hot-air engines that came afterwards. It really was as late as the second half of the 20th century before Stirling engines began to receive the attention they deserved. I will continue the story in the next part of this article.

6. Acknowledgements

I would like to thank Allan Mills for his encouragement to write this article and for supplying Fig.11; the archives departments of the Universities of Edinburgh and Glasgow for information on Stirling's University careers; The Hunterian Museum, Glasgow, for Fig. 8; Aberdeen City Library for access to THE ENGINEER mentioned in ref. 6.; the Energy Saving Advisor for permission to reproduce Fig. 12 and Galston Parish Church for Fig. 13.

Footnotes, including references

1. This comment is made in the 1876 Institution of Civil Engineers obituary for James Stirling, published in Grace's Guide to British Industrial History.

2. Robert Stirling's Edinburgh first degree years are noted by his signature in the enrolment book Edinburgh University Matriculation Roll, Arts Law and Divinity, II, 1775-1810, University Of Edinburgh Main Library, Special Collections.
He signed the original matriculation book in 1805-06 and in 1806-07.
The signature Robert Stirling in 1808-09 appears to be in a different hand.
'Private' students did not have to sign the register.

3. John Leslie An Experimental Inquiry into the Nature and Propagation of Heat J. Mawman, London, 1804.

4. To go on to study Divinity, Robert Stirling notionally required an AM degree first but in his day graduation was not popular, for it was a considerable expense over and above attending courses. Alexander Grant in "The Story of the University of Edinburgh in its first 300 years" vol. I, pp 281 – 282, (Longmans, Green, & Co., London 1884) describes how attendance at specific courses in a Scottish University was accepted in lieu of an AM degree (the predecessor of the MA).
Natural Philosophy was a required course. At the time, the University of Edinburgh did not keep records of all attending their courses, nor did the University of Glasgow that he would also attend.

5. Fasti Ecclesiæ Scoticanæ, Ed. Hew Scott, vol. 3, p 40, Oliver & Boyd, Edinburgh, 1920.
It is stated here explicitly that he attended the University of Glasgow.

6. Stirling's patent "Improvements for Diminishing the Consumption of Fuel, and in particular an engine capable of being Applied to the Moving of Machinery on a Principle Entirely New" is reproduced in Allan J. Organ, Thermodynamics and Gas Dynamics of the Stirling Cycle Machine, appendix AI.2, pp288 – 293 (CUP, 1992).
The patent was actually granted in January 1817.
The patent can also be found, with illustrations, in THE ENGINEER, vol. 124, pp 516 – 517, Dec. 1917 in an article marking its centenary.

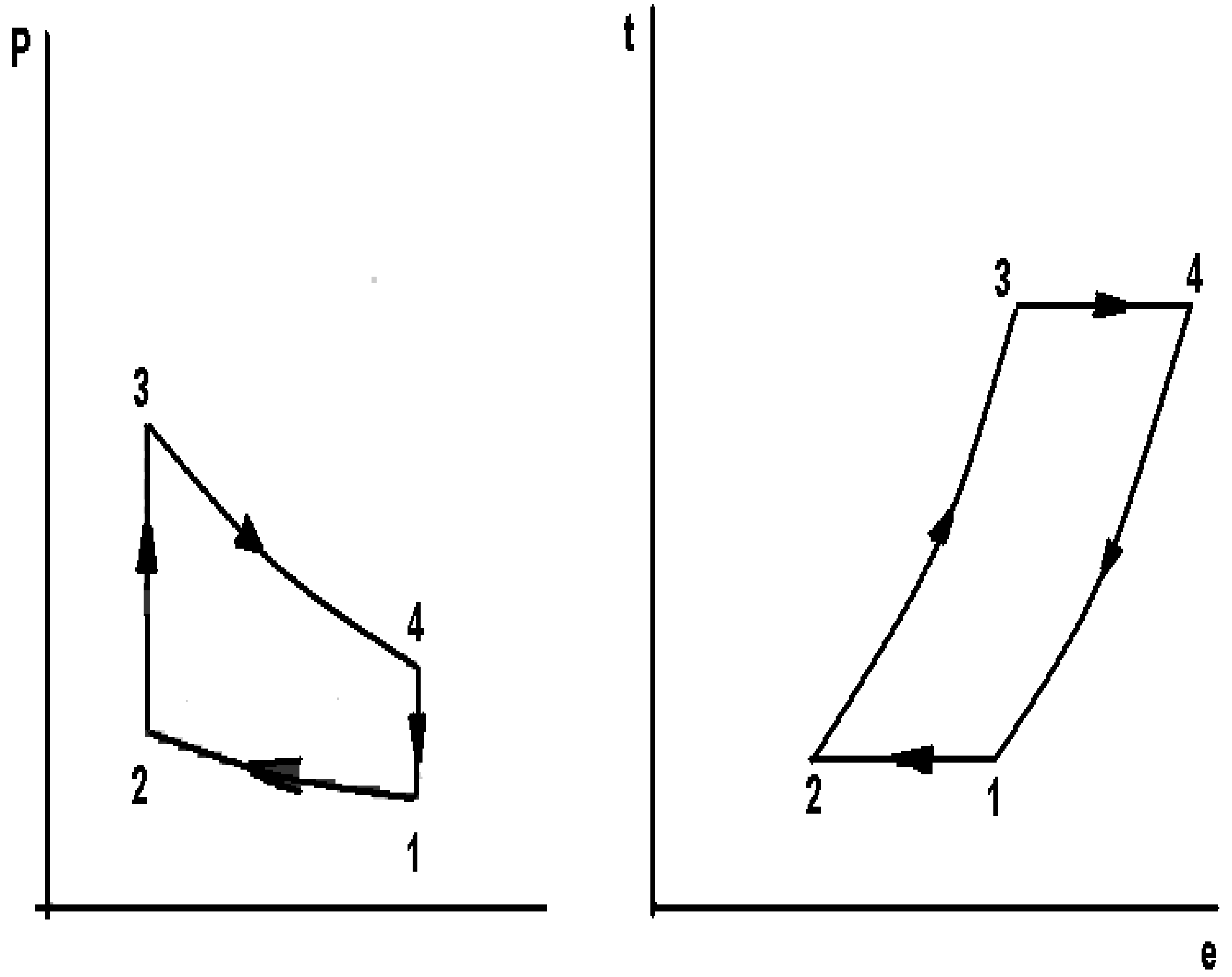
7. The patent begins "All my Improvements for diminishing the consumption of fuel consist of the different forms or modifications of a New Method, Contrivance, or Mechanical arrangement for heating and cooling Liquids, Airs or Gasses,

and other Bodies by the use of which Contrivance
Heat is abstracted from one portion of such liquids, airs, and other bodies and communicated to another portion with very little loss…”.

8. William John Macquorn Rankine “On the geometrical representation of the expansive action of heat, and the theory of thermodynamic engines”, Phil Trans. Roy. Soc. Vol 144, pp 115 – 175, 1854.

9. The analysis can be found on this and related web pages. http://zigherzog.net/stirling/DrIz/isothermal/Schmidt.html accessed 13/12/2015.

10. Several textbooks dealing solely with the Stirling Engine are devoted to both theoretical and practical issues. One often quoted example is G. Walker “Stirling Cycle Machines”, OUP 1973.



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About the Romanian Chemist Nicolae Teclu

Despre chimistul român Nicolae Teclu

Nicolae Teclu (1839-1916) is very well-known in Romania and the whole wide world as a great chemist and inventor of laboratory equipment and measuring instruments (Fig. 1 and Fig.2).

Fig. 1. **Nicolae Teclu at 59 years old**

Nicolae Teclu was born in Brasov, on 18th October 1839. He followed the Secondary School in his hometown, where he also attended the high school and finally he graduated in Vienna. Then, he attended the courses at the Academy of Fine Arts in München, and got a degree in architecture in Berlin. Meanwhile, he also attended courses of engineering and general and analytical chemistry at Politechnic School in Vienna.

After getting his degree in 1863, he returned to Brasov to work as a teacher. In 1868, at the invitation of his teacher, Dr. Ludwig Boltzmann, who recognized his exceptional qualities as a teacher and chemist, Teclu returns to Vienna as an assistant and then as professor of General Chemistry at the Academy of Commerce, and later, as professor of the chemistry of Pigments at the Academy of Fine Arts .

As chemist, Nicolae Teclu is internationally recognized due to one of its important inventions – the "Teclu burner" , a laboratory appa-

Nicolae Teclu (1839-1916) este cunoscut în România şi în lume ca mare chimist, inventator de aparate de laborator şi instrumente de măsurare (Fig. 1).

Nicolae Teclu s-a născut în Braşov

Fig. 2. Nicolae Teclu at 70 years old

la 18 octombrie 1839. Şcoala generală o urmează în oraşul natal, unde începe apoi şi liceul, pe care îl termină la Viena.

Urmează secţia de Arhitectură la Academia de Arte Frumoase din München şi obţine licenţa în arhitectură la Berlin. In aceeaşi perioadă, urmeză cursuri de inginerie şi chimie generală şi analitică la Şcoala Politehnică din Viena.

După terminarea studiilor universitare în 1863, Nicolae Teclu activează ca profesor la un gimnaziu din Braşov. In 1868, la invitaţia profesorului său, dr. Ludwig Boltzmann, care îi recunoştea calităţile excepţionale de pedagog şi chimist, Teclu se întoarce la Viena, ca asistent apoi ca profesor de chimie generală la Academia de Comerţ şi ulterior, profesor de chimia pigmenţilor la Academia de Arte Frumoase.

Ca chimist, Nicolae Teclu este recunoscut internaţional datorită uneia dintre marile sale invenţii: "becul de gaz Teclu" care este un aparat de laborator pentru producratus used for for produce an open flame (in the atmosphere) with combustion gas heating the laboratory chemical preparations (Fig. 3).

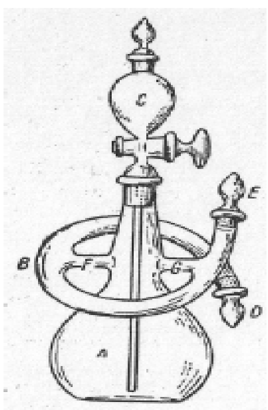
The Teclu burner is used today in chemistry laboratories around the world and it is similar to the Bunsen burner (Fig. 4), invented by Robert Bunsen (1811-1899). The difference is that the gas fueling the Teclu burner is controlled with a conical shutter. Thus, a better mixture of the air with the fuel gas is achieved, and, as a result, the flame reaches temperatures above 1500oC.

Fig. 3. **Teclu burner**

Fig. 4. **Bunsen burner**

Among his inventions, alongside about Teclu burner we talked about, we also mention a series of laboratory glass appliances, such as electrolysis device to obtain carbon dioxide (Fig. 5).

Using electricity, Nicolae Teclu built several types of devices for water electrolysis (Fig. 6).



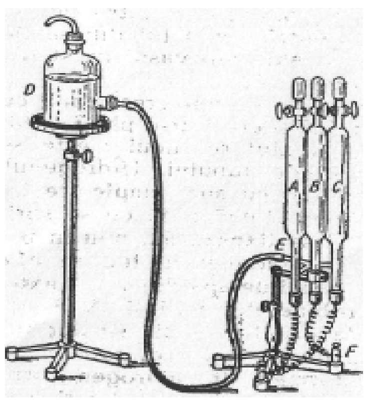


Fig. 4. 5. **Device for obtaining carbon dioxide**
Vas pentru obţinerea bioxidului de carbon

Fig. 5. 6. **Device for water electrolysis**
Aparat pentru electroliza apei

erea flăcării deschise (în atmosferă) cu un gaz de combustie, utilizat pentru încălzirea preparatelor chimice de laborator (Fig. 2).

Becul Teclu este folosit şi astăzi în laboratoarele de chimie din lume şi este asemănător cu becul Bunsen (Fig. 3), inventat de Robert Bunsen (1811-1899).

Deosebirea este că reglarea admisiei combustibilului la becul Teclu se face cu un obturator conic şi, în felul acesta, se obţine un amestec mai bun al aerului cu gazul combustibil, astfel că temperatura flăcării ajunge la peste 1500oC.

Printre invenţiile sale, alături de becul Teclu despre care am vorbit, menţionăm şi o serie de aparate de laborator din sticlă, cum este vasul pentru obţinerea bioxidului de carbon (Fig. 4).

Folosind curentul electric, Nicolae Teclu a construit mai multe tipuri de aparate pentru electroliza apei (Fig. 5).

Pentru a se evita explozia gazului grizu (amestec de metan şi aer), Teclu a conceput şi realizat un aparat pentru măsurarea compoziţiei aerului din mină.

De asemenea, pentru obţinerea ozonului utilizat la sterilizarea produselor, Nicolae Teclu a realizat mai multe tipuri de ozonizatoare (Fig. 6).

Lucrările importante de cercetare ale lui Nicolae Teclu cuprind:

- Studii de rezistenţă a hârtiei şi a fibrelor lemnoase;
- Producerea de uleiuri şi pigmenţi minerali utilizaţi în artă;
- Studii privind combustia controlată a gazelor.

Nicolae Teclu a fost cel dintâi care a demonstrat posibilitatea cit-

To avoid explosion of firedamp (mixture of methane and air), Teclu has conceived and built a device for measuring the mine air composition.

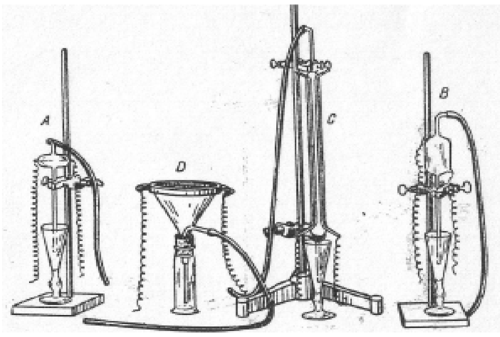


Fig. 6. Devices for ozone producing, designed by Nicolae Teclu

Fig. 6. Ozonizatoare concepute de Nicolae Teclu

The major researches of Nicolae Teclu include:

- Studies regarding the strength of paper and wood fibers;
- Production of oil and mineral pigments used in art;
- Studies on the controlled combustion of gases.

Nicolae Teclu was the first to demonstrate the posibility of reading the writings on the charred papers.

For his merits, Nicolae Teclu was elected member of the Romanian Academy in 1878.

Today, his name is carried by more than 15 high schools of chemistry from Romania, and there is an Romanian Academy Award named “Nicolae Teclu” granted for researches in chemistry. Appliances and his inventions have penetrated in all chemistry laboratories of the world.

Iconography

Fig.1: http://noema.crifst.ro/nr15en.php
Fig.2: http://www.sciencedirect.com/science/article/pii/0039914083800356
Fig.3: http://www.turbosquid.com/3d-models/3d-model-bunsen-burner/637326
Fig.4, Fig. 5: Macarovici C.Gh., Schmidt G., Nicolae Teclu, Bucureşti, Editura Stiinţifică, 1971

Fig.6: http://canov.jergym.cz/nadobi/kahany/teclu.htm

irii înscrisurilor de pe hârtiile carbonizate.

Pentru meritele sale, Nicolae Teclu a fost ales membru al Academiei Române în anul 1878.

Astăzi, numele său este purtat de peste 15 licee cu profil de chimie din România şi există un premiu al Academiei Române intitulat „Nicolae Teclu” care se acordă pentru cercetări în domeniul chimiei.

Aparatele şi invenţiile sale au pătruns în mai toate laboratoarele de chimie din lume.

Bibliography

1. Macarovici C.Gh., Schmidt G., Nicolae Teclu, Bucureşti, Editura Ştiinţifică, 1971.
2. Chicomban M, Medalion Nicolae Teclu la Casa Baiulescu, Bună Ziua Braşov, 13 ianuarie 2001.
3. Şerban D.P., Nicolae Teclu (1839 – 1916). 100 de ani de la moartea sa, http://noema.crifst.ro nr15en.php
4. Baiulescu G.E., Moldoveanu S., Nicolae Teclu (1839–1916): A pioneer of flame spectroscopy, http://www.sciencedirect.com/science/article/pii/0039914083800356

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Crystals in Plants

By the term crystals we define the organic or mineral deposits (mainly salts) in crystalline form. Crystalline inclusions have been observed both in animals and plants organisms. In plants, however, the crystals mainly perform a functional role.

The crystals are classified in the following three categories depending on the compound contained:

- Calcium oxalate crystals
- Crystalline or amorphous calcium carbonate (cystoliths)
- Crystalline or amorphous silicaor silica-oxides (phytoliths)

1. Calcium oxalate crystals

Calcium oxalate crystals can be found in more than 250 plant families. Their presence in plants was first written down in 1675 by Leeuwenhoek, a Dutch scientist who observed them using an optical microscope. It has been observed that plants can accumulate crystals at a rate of 3-80% of their dry weight in almost all their organs and tissues. In fact, the amount of calcium deposited in the crystals can be up to 90% of the plant's total calcium amount.

They are a compound of calcium cations and oxalic acid, a common byproduct of photosynthesis. They can be found in epidermal and subdermal cells, in the cell walls or in the vacuoles of specialized cells called idioblasts located mainly in the mesophyll (Fig. 1).

The function of the idioblasts is of great interest, since they can handle and accumulate large amounts of calcium.

Depending on their shape and size, calcium oxalate crystals are classified in the following categories (Fig. 2):

- Raphides: Elongated and thin needle-shaped crystals.
- Styloids: Crystals with pointed ends and their length is at least four times their width.

Κρύσταλλοι μέσα στα φυτά

Με τον όρο κρύσταλλοι περιγράφονται οι εναποθέσεις οργανικών ή ανόργανων συστατικών (κυρίως αλάτων) σε κρυσταλλική μορφή. Όπως στους ζωικούς οργανισμούς έτσι και στους φυτικούς έχουν παρατηρηθεί κρυσταλλικά έγκλειστα. Στα φυτά, όμως, οι κρύσταλλοι έχουν κυρίως λειτουργικό ρόλο. Οι κρύσταλλοι ταξινομούνται στις εξής τρεις κατηγορίες ανάλογα με την ένωση που περιέχουν:

- Κρύσταλλοι οξαλικού ασβεστίου
- Κρυσταλλικό ή άμορφο ανθρακικό ασβέστιο (κυστόλιθοι)
- Κρυσταλλικό πυρίτιο ή αμορφα σωματίδια οξειδίων του πυριτίου (φυτόλιθοι)

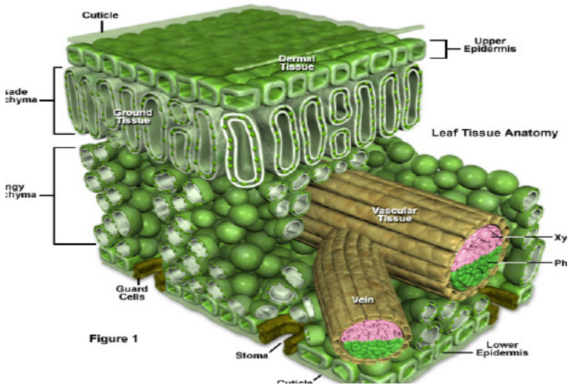
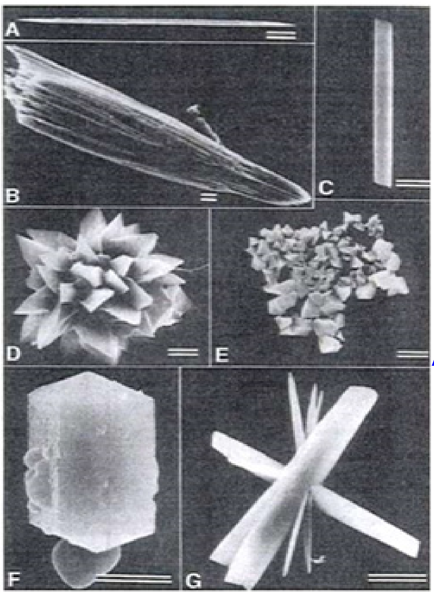


Fig. 1: Mesofyll structure. The inner section of the leaf between the upper and lower surface whith photosynthesising cells (palisade and spongy cells)

Εικ. 1: Δομή μεσοφύλλου. Τομή εσωτερικού του φύλλου μεταξύ της άνω και της κάτω επιφάνειας με τα φωτοσυνθετικά κύτταρα (κύτταρα σπογγώδους και δρυφρακτοειδούς παρεγχύματος).

1. Κρύσταλλοι οξαλικού ασβεστίου

Οι κρύσταλλοι οξαλικού ασβεστίου εμφανίζονται σε περισσότερες από 250 φυτικές οικογένειες. Η ύπαρξή τους στα φυτά καταγράφηκε για πρώτη φορά το 1675 από τον Ολλανδό Leeuwenhoek, ο οποίος τους παρατήρησε με τη χρήση απλού οπτικού μικροσκοπίου. Έχει παρατηρηθεί πως τα φυτά μπορεί να συσσωρεύουν τους κρυστάλλους



Micrographs of isolated calcium oxalate crystals by SEM.
A: Single raphide bundle of Psychotria punctata (Rubiaceae).
B: Leafe raphide crystal bundle of Psychotria punctata.
C: Styloid crystal from leaf spongy mesofyll of Peperomia (Piperaceae).
D: Druse crystal from leaf of Opuntia (Cactaceae).
E: Crystal sand from petiole of Nicotiana glauca (Solanaceae).
F: Prismatic crystals from leaf of Begonia (Begoniaceae).
G: Aggregate crystal complex from leaf spongy mesofyll of Peperomia astrid (Piperaceae). All line scales equal 5 μm.

Μικροφωτογραφίες μεμονωμένων κρυστάλλων οξαλικού ασβεστίου από ΗΜΣ.
A: Μία ραφίδα από δέσμη του φυτού Psychotria punctata (Rubiaceae).
B: Δέσμη ραφίδων φύλλου του Psychotria punctata.
C: Στυλοειδής κρύσταλλος σπογγώδους παρεγχύματος μεσοφύλλου του Peperomia (Piperaceae).
D: Δρούσα φύλλου του Opuntia (Cactaceae).
E: Κρυσταλλική άμμος από μίσχο του Nicotiana glauca (Solanaceae).
F:Πρισματικοί κρύσταλλοι φύλλου βιγκόνιας (Begoniaceae).
G:Αστεροειδές συσσωμάτωμα συμφυών κρυστάλλων σπογγώδους παρεγχύματος μεσοφύλλου του Peperomia astrid (Piperaceae).
Η κλίμακα όλων των γραμμών, που απεικονίζονται αντιστοιχεί σε 5μm

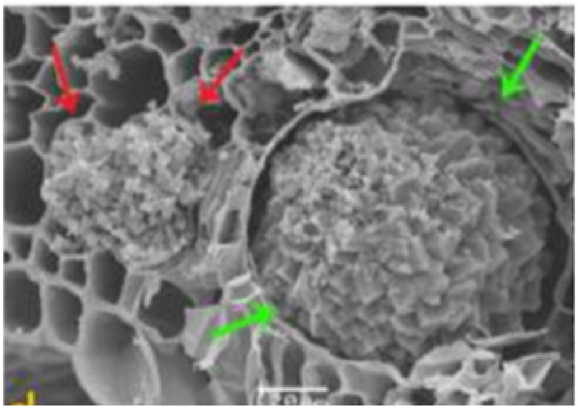


Fig. 3: **Electron microscope image of a druse (green arrows) and crystal sand (red arrows) in adult amaranth leaf**
Εικ. 3: Φωτογραφία από ηλεκτρονικό μικροσκόπιο μιας δρούσας (πράσινα βέλη) και κρυσταλλικής άμμου (κόκκινα βέλη) σε ώριμο φύλλο βλήτου.

- Druses (Fig. 3): Aggregates of individual crystals consisting of numerous prism or pyramid crystals.
- Prismatic crystals: rhombohedral or octahedral crystals that vary in size.
- Crystal sand: A mass of thin solid micro crystals that are dispersed in the cells giving them a sandy texture.

Various hypotheses have been formulated

σε ποσοστό 3-80% του ξηρού τους βάρους σε όλα σχεδόν τα όργανα και τους ιστούς. Μάλιστα, η ποσότητα ασβεστίου που εναποτίθεται στους κρυστάλλους μπορεί να φθάσει και το 90% του συνολικού Ca του φυτού.

Σχηματίζονται από την ένωση κατιόντων ασβεστίου με το οξαλικό οξύ, παραπροϊόν της φωτοσύνθεσης. Συναντώνται σε τρίχες, στα επιδερμικά και υποδερμικά κύτταρα, στα κυτταρικά τοιχώματα ή στα χυμοτόπια εξειδικευμένων κυττάρων, που ονομάζονται ιδιοβλάστες και βρίσκονται κυρίως στην περιοχή του μεσόφυλλου (Εικ. 1). Η λειτουργία των κυττάρων αυτών παρουσιάζει εξαιρετικό ενδιαφέρον, αφού διακινούν και συσσωρεύουν μεγάλα ποσά ασβεστίου.

Ανάλογα με το μέγεθος και το σχήμα τους οι κρύσταλλοι διακρίνονται στις εξής κατηγορίες (Εικ. 2):

- Ραφίδες : Επιμήκεις, λεπτοί και βελονοειδείς κρύσταλλοι
- Στηλοειδείς: Κρύσταλλοι με μυτερές απολήξεις και μήκος τουλάχιστον τέσσερις φορές μεγαλύτερο από το πλάτος.
- Βοτρυόμορφοι-δρούσες (Εικ. 3): Σύνθετοι κρύσταλλοι

about the physiological function of crystals in plants though none is scientifically completely verified. According to the main hypothesis the crystals are used as calcium depositories for future need of the plants. This concept has been reinforced by the observation that some crystals seem to be absorbed by the plant on occasions of calcium deficiency. Also, it is assumed that the crystals constitute a fundamental defense mechanism against herbivorous animals and phytopathogenic fungi. Their presence may automatically injure herbivorous animals or cause damage to their kidneys or kill phytopathogenic fungi by their degradation and release of oxalic acid.

The oxalic acid is considered to be a by-product of metabolism and especially toxic for the plant. Consequently, the formation of oxalic calcium crystals may be used as a means of oxalic acid inactivation. Furthermore, they may contribute to the inactivation of heavy metals and aluminum. Finally, it is assumed that in certain plant species that the crystals may contribute to light diffusion in the plant cells and, therefore, to more effective light scattering from the photosynthetically less efficient upper layer to the photosynthetically more efficient lower layers of the photosynthetic tissue (Fig. 4).

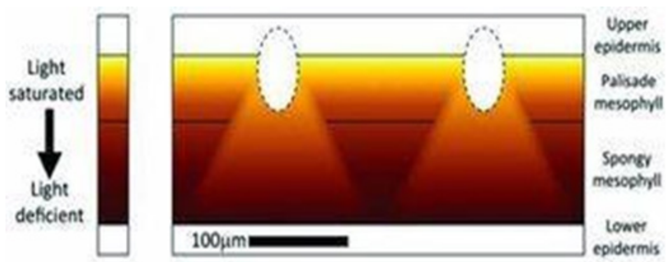


Fig. 4: Schematic mesofyll display illustrates how light is scattered from the crystals of upper mesophyll cells (scatterers) to the lower mesophyll. The flux through the tissue is effective if a cone of approximately 60° is formed.
Εικ. 4: Σχηματική παράσταση μεσοφύλλου. Φαίνεται πώς το φως σκεδάζεται από τους κρυστάλλους των κυττάρων του ανώτερου μεσοφύλλου (σκεδαστές) προς το κατώτερο μεσόφυλλο. Η ροή μέσω των ιστών είναι ικανοποιητική αν ο σχηματιζόμενος κώνος είναι περίπου 60°.

(συνδιαβλαστάνοντες) αποτελούμενοι από πολυάριθμους πρισματοειδείς ή πυραμιδοειδείς κρυστάλλους.

- Πρισματικοί: Ρομβοεδρικοί ή οκταεδρικοί κρύσταλλοι που ποικίλουν σε μέγεθος.
- Κρυσταλλική άμμος: μάζα λεπτών συμπαγών μικρο-κρυστάλλων που είναι διασκορπισμένοι στα κύτταρα δίνοντάς τους αμμώδη υφή.
- Σφαιρίτες: Σφαιρικοί κρύσταλλοι, που συγκροτούν ομάδες και έχουν σχετικά λεία επιφάνεια.

Αν και καμία δεν είναι επιστημονικά πλήρως αποδεδειγμένη, διάφορες υποθέσεις έχουν διατυπωθεί για την φυσιολογική σημασία των κρυστάλλων στους φυτικούς οργανισμούς. Αρχικά, οι κρύσταλλοι μπορεί να χρησιμεύουν ως αποθήκες ασβεστίου για τις μελλοντικές ανάγκες του φυτού. Η άποψη αυτή ενισχύεται από την παρατήρηση ότι κάποιοι κρύσταλλοι φαίνεται να απορροφώνται από το φυτό σε καταστάσεις έλλειψης ασβεστίου. Εικάζεται επίσης ότι οι κρύσταλλοι αποτελούν έναν βασικό μηχανισμό άμυνας έναντι φυτοφάγων ζώων και φυτοπαθογόνων μυκήτων. Η παρουσία τους μπορεί να τραυματίζει μηχανικά τα φυτοφάγα ζώα ή να προκαλεί βλάβες στα νεφρά τους, ενώ με την αποδόμηση τους και την απελευθέρωση οξαλικού οξέος να σκοτώνουν τους φυτοπαθογόνους μύκητες.

Το οξαλικό οξύ θεωρείται ένα παραπροϊόν του μεταβολισμού και ιδιαίτερα τοξικό για το φυτό. Κατά συνέπεια, ο σχηματισμός κρυστάλλων οξαλικού ασβεστίου μπορεί να χρησιμεύει ως μέσο αδρανοποίησης του οξαλικού οξέως. Ομοίως μπορεί να συνεισφέρει στην αδρανοποίηση των βαρέων μετάλλων και του αργιλίου. Τέλος, σε ορισμένα είδη φυτών εικάζεται ότι οι κρύσταλλοι μπορεί να συμβάλλουν στη διάχυση και κατά συνέπεια την αποτελεσματικότερη διάδοση του φωτός από τις ανώτερες φωτοσυνθετικά αποδοτικές στις κατώτερες λιγότερο αποδοτικές στιβάδες του φωτοσυνθετικού ιστού. (Εικ. 4).

βρίσκονται σε συνθήκες έλλειψης άνθρακα, για παράδειγμα όταν τα στόματα είναι κλειστά κατά τη διάρκεια της ημέρας λόγω αντίξοων

Agricultural University of Athens, crystals are a fundamental survival mechanism. In carbon deficiency conditions, for example when the stomata are closed during daytime due to inclement weather conditions, the dissolution of oxalate and carbonate calcium could supply the necessary CO_2 for the function of photosynthesis without having the stomata open ensuring in this way its maintenance of water. Afterwards, in optimal conditions or during the night when the photosynthesis is not in function, the "command" for the crystals to be reformed could be given.

We conclude that there are various functions attributed to the calcium oxalate crystals. Each role does not necessarily ban the other, especially if we take into consideration the vast variety in the shape and size of the crystals and the morphology of idioblasts.

2. Cystoliths

In members of some plant families a deposition of amorphous calcium carbonate is observed.

This salt is deposited either in the cell walls or in specialized cells called lithocysts.

Lithocysts are bulky idioblasts cells, in which calcium carbonate is deposited in the form of cystoliths.

Cystoliths are also formed in some plants of agricultural interest, such as the mulberry, the fig tree and Parietaria Judaica (Fig. 5).

The formation of the crystals depends on a number of factors, such as the nutritional status of the plant tissue, the age of the plant, calcium sufficiency, the light intensity as well as the time of day (in terms of temperature change).

It is known that in young plant tissues both the number and the density of the crystals are high, because there is a greater need for protection than in a mature plant tissue.

It is worth mentioning that the crystal size (and not how many they are) seems to vary from day to night , as it is reduced during daytime and increase during the night.

περιβαλλοντικών συνθηκών, η διάσπαση του οξαλικού ασβεστίου θα μπορούσε να προμηθεύσει το απαραίτητο CO_2 για την λειτουργία της φωτοσύνθεσης χωρίς να χρειαστεί να ανοίξουν τα στόματα και κατά συνέπεια να υπάρξει απώλεια νερού. Στη συνέχεια, όταν οι συνθήκες γίνουν κατάλληλες ή κατά τη διάρκεια της νύχτας που δεν λειτουργεί η φωτοσύνθεση, θα μπορούσε να δοθεί η «εντολή» επαναδημιουργίας των κρυστάλλων.

Συμπεραίνουμε ότι υπάρχουν ποικίλες λειτουργίες που αποδίδονται στους κρυστάλλους οξαλικού ασβεστίου. Φυσικά κάθε ρόλος δεν αποκλείει αναγκαστικά έναν άλλο, ειδικά αν λάβουμε υπόψη μας την τεράστια ποικιλία στο σχήμα και στο μέγεθος των κρυστάλλων και στη μορφολογία των ιδιοβλαστών

2. Κυστόλιθοι

Σε μέλη κάποιων φυτικών οικογενειών παρατηρείται η εναπόθεση κρυσταλλικού ή άμορφου ανθρακικού ασβεστίου. Το άλας αυτό εναποτίθεται είτε στα κυτταρικά τοιχώματα των κυττάρων είτε σε εξειδικευμένα κύτταρα που ονομάζονται λιθοκύστεις.

Οι λιθοκύστεις αποτελούν ογκώδη ιδιόβλαστα κύτταρα, στα οποία πραγματοποιείται η εναπόθεση του ανθρακικού ασβεστίου με τη μορφή κυστόλιθων.

Κυστόλιθοι σχηματίζονται και σε ορισμένα φυτά γεωργικού ενδιαφέροντος, όπως η μουριά, η συκιά και το περδικάκι (Εικ. 5).

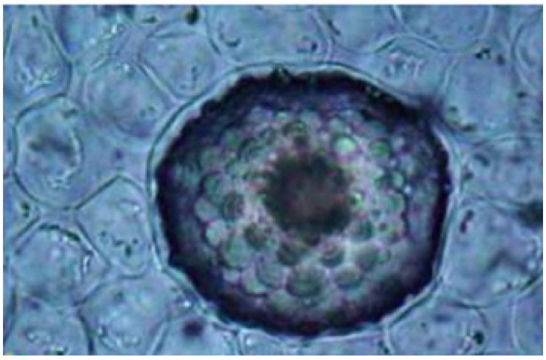


Fig. 5: **Cystolith in lithocyst in a faded adult leaf of Parietaria judaica (use of multifocal lens)**

Εικ. 5: Κυστόλιθος μέσα σε λιθοκύστη σε αποχρωματισμένο ώριμο φύλλο Parietaria judaica (πολυεστιακή φωτογράφιση).

3. Phytoliths

In certain plant species silica particles are formed in a crystalline or amorphous type. Though they are less frequent, there is important indication, that one significant function of them is the protection of plants against herbivorous animals or phytopathogenic fungi.

Phytoliths are useful diagnostic tools in archaeology and palaeobotany. Since their formation is genetically controlled they are used as a taxonomical feature because they remain in soil unchanged for many million years.

It's easy for a plant to be recognised by the shape and size of phytoliths (Fig. 6). By examining the different features of phytoliths, we configurate a picture about the vegetation of the era examined and date back the fossils.

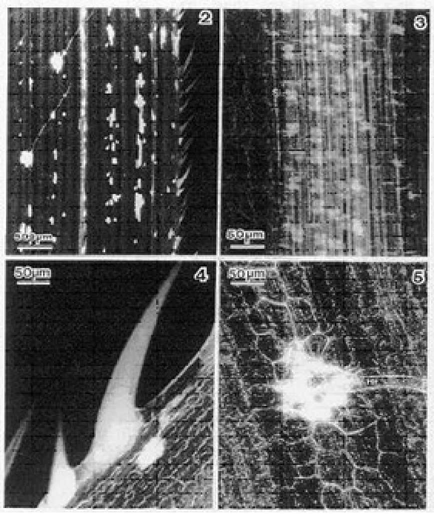


Fig. 6: **Phytoliths in plant epidermis (X-ray picture, Cheng, 1989)**
Εικ. 6: Φυτόλιθοι σε επιδερμίδα φυτού (Φωτογραφία ακτίνων-Χ, Cheng, 1989).

4. History

Since the first observation of crystal by Leeuwenhoek in 1675 till now, the crystal findings within plants have followed the evolution of the capabilities of microscopes.

Till 1864 raphides and other crystals had already been observed in many plant families as Vitaceae, Zygophyllaceae, Melastomaceae, Passifloraceae, Compositae, Oleaceae, Orchidaceae, Iridaceae, Amaryllidaceae and others. Gradually more and more

Ο σχηματισμός των κρυστάλλων επηρεάζεται από μια σειρά παραγόντων όπως η γενική θρεπτική κατάσταση του φυτικού ιστού, η ηλικία του φυτού, η επάρκεια σε ασβέστιο, η ένταση της φωτεινής ακτινοβολίας και η ώρα της ημέρας (θερμοκρασία).

Είναι γνωστό ότι σε νεαρούς φυτικούς ιστούς τόσο ο αριθμός όσο και η πυκνότητα των κρυστάλλων είναι αυξημένα, καθώς υπάρχει ανάγκη για περισσότερη προστασία απ' ότι σε έναν ώριμο.

Αξίζει να σημειωθεί ότι το μέγεθος των κρυστάλλων (όχι ο αριθμός) φαίνεται να παρουσιάζει ημερονύκτια διακύμανση, καθώς μειώνεται κατά τη διάρκεια της μέρας και αυξάνεται κατά τη διάρκεια της νύχτας.

4. Ιστορικά Στοιχεία

Από την πρώτη παρατήρηση κρυστάλλου από τον Leeuwenhoek το 1675 μέχρι σήμερα, τα ευρήματα κρυστάλλων μέσα στα φυτά έχουν ακολουθήσει την εξέλιξη των δυνατοτήτων των μικροσκοπίων.

Μέχρι το 1864, ραφίδες και άλλοι τύποι κρυστάλλων έχουν ήδη παρατηρηθεί μέσα σε πολλές οικογένειες φυτών όπως οι Vitaceae, Zygophyllaceae, Melastomaceae, Passifloraceae, Compositae, Oleaceae, Orchidaceae, Iridaceae, Amaryllidaceae και άλλες. Σταδιακά καταγράφονταν όλο και περισσότερα είδη φυτών, που περιείχαν κρυστάλλους διαφόρων τύπων σε διάφορες θέσεις.

Η χρήση των ηλεκτρονικών μικροσκοπίων απεκάλυψε την τρισδιάστατη δομή των κρυσταλλικών συσσωματωμάτων ή μονοκρυστάλλων, λεπτομέρειες της επιφάνειάς τους και την χημική τους δομή με μικροανάλυση ακτίνων-Χ.

Το πρωτότυπο ηλεκτρονικό μικροσκόπιο με δυνατότητα να μεγεθύνει 400 φορές κατασκευάσθηκε το 1931. Το 1939 κατασκευάστηκε το ηλεκτρονικό μικροσκόπιο διελεύσεως (ΗΜΔ) από τη Siemens. Το ΗΜΔ με δυνατότητα μεγέθυνσης δύο εκατομμύρια φορές δεν είναι κατάλληλο για παρατήρηση κρυστάλλων φυτών επειδή η προετοιμασία του δείγματος απαιτεί λεπτές τομές και καθίστανται δύσκολες λόγω της σκληρότητας των κρυστάλλων. Το ηλεκτρονικό plant species were written down as containing crystals of various types at certain sites.

Using electron microscopes the 3D structure of crystal aggregates or monocrystals was revealed as well as details of their surface and also the chemical structure by X-Ray microanalysis.

The prototype electron microscope was constructed in 1931, capable of four-hundred-power magnification. In 1939 a transmission electron microscope (TEM) was produced by Siemens.

The transmission electron microscope, capable of two million-power magnification, is not suitable for observation of crystals in plants because the specimen preparation requires thin sections and it turns difficult to be cut because of the crystal hardness. The image resolution of a scanning electron microscope (SEM) is at least an order of magnitude poorer than that of a TEM. However, SEM can produce images that are good representations of the three-dimensional shape of the sample.

Some types of detectors used in SEM have analytical capabilities, and can provide several items of data as the Energy-dispersive X-ray spectroscopy (EDS) detectors used in elemental analysis (we use them for crystal microanalysis).

Journals

Vincent R. Franceschi and Harry T. Horner, "Calcium oxalate crystals in plants", Botanical Review, Vol. 46, No. 4 (Oct. - Dec., 1980), pp. 361-427.

Gal A1, Brumfeld V, Weiner S, Addadi L, Oron D., "Certain biominerals in leaves function as light scatterers", Adv. Mater., Vol 24, (10), 2012, pp.77-83.

Prof. George Karabourniotis

μικροσκόπιο σαρώσεως (ΗΜΣ) έχει διακριτική ικανότητα τουλάχιστον μια τάξη μεγέθους μικρότερη. Εν τούτοις δίνει καλές τρισδιάστατες αναπαραστάσεις του τρισδιάστατου σχήματος του δείγματος. Μερικοί ανιχνευτές, που χρησιμοποιούνται στα ΗΜΣ έχουν δυνατότητες ανάλυσης, όπως οι ανιχνευτές φασματοσκοπίας ακτίνων-Χ, που χρησιμοποιούνται για στοιχειακή ανάλυση (τους χρησιμοποιούμε για την μικροανάλυση των κρυστάλλων).

References ***Books***

Tooulakou G., Thesis, "The effect of insufficiency of carbon on calcium oxalate crystals and metabolic model Amaranthus sp.: metabolomics analyzing", Agricultural University of Athens, 2006.

Giannopoulos, A., P., Thesis, "The Structure and Function of idioblasts deposit-forming oxalate and calcium carbonate and their Role in Alarm Photosynthesis", Agricultural University of Athens, 2014.

George Gulliver, F. R. S., "Observations on Raphides and other Crystals in Plants" in "THE ANNALS AND MAGAZINE OF NATURAL HISTORY", VOL. IV, THIRD SERIES, p. 38-40, London, Printed and published by Taylor and Francis, No 85, January 1865.

Webology

Persaits, G., http://www.phytolith.eu/en/what-is-the-phytolith, Dr. Gergő Persaits, "What is a phytolith", University of Szeged, Szeged

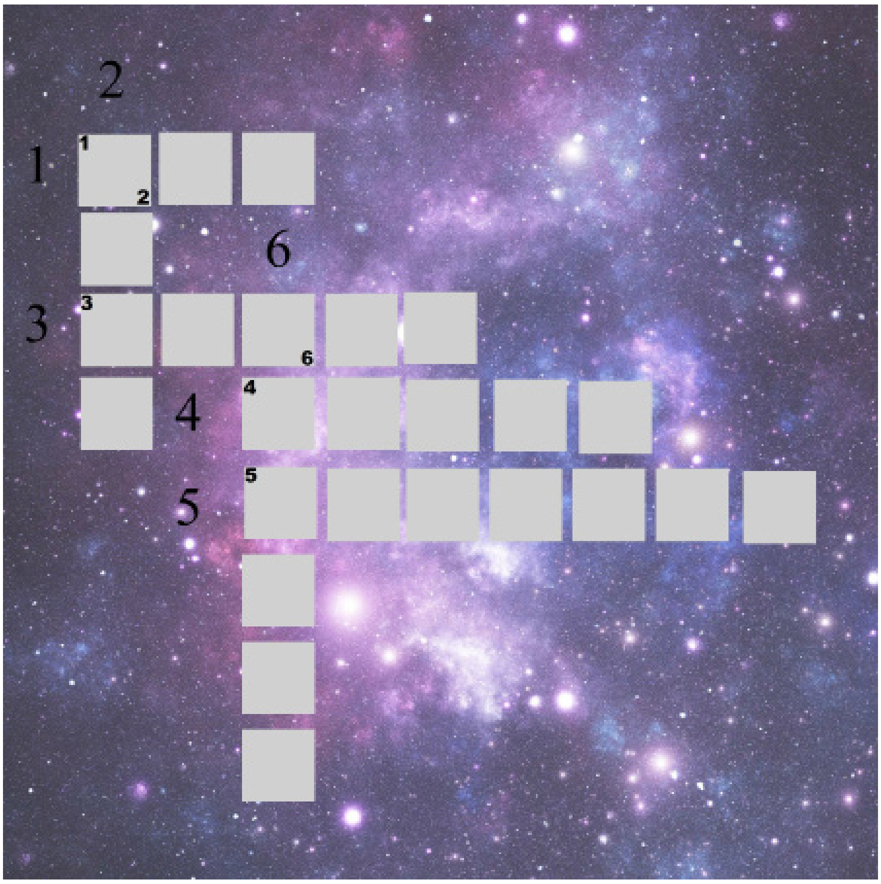
Interview

Interview from the supervisor of two theses, Dr. George Karabourniotis, Prof. of Plant Physiology and Morphology, Agricultural University of Athens, Faculty of Crop Science

FUN PAGE

THE STARS CROSSWORD

by Simone Giusti



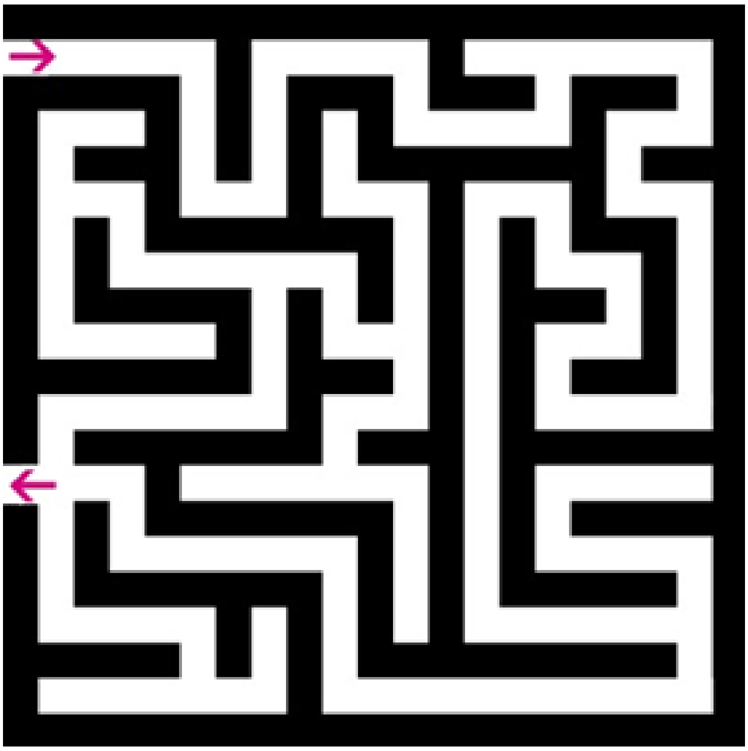
1. Mother star of solar system.
2. The brightest star in the night sky.
3. The Most luminous star in the Orion constellation.
4. A star system consisting of three components, the constellation of Southern Cross.
5. It is in the southern constellation of centaurus.
6. The third brightest star in the constellation of the Southern Cross

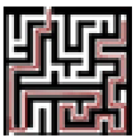
FUN PAGE

The Labyrinth

Complete the labyrinth

by Diego Trapani

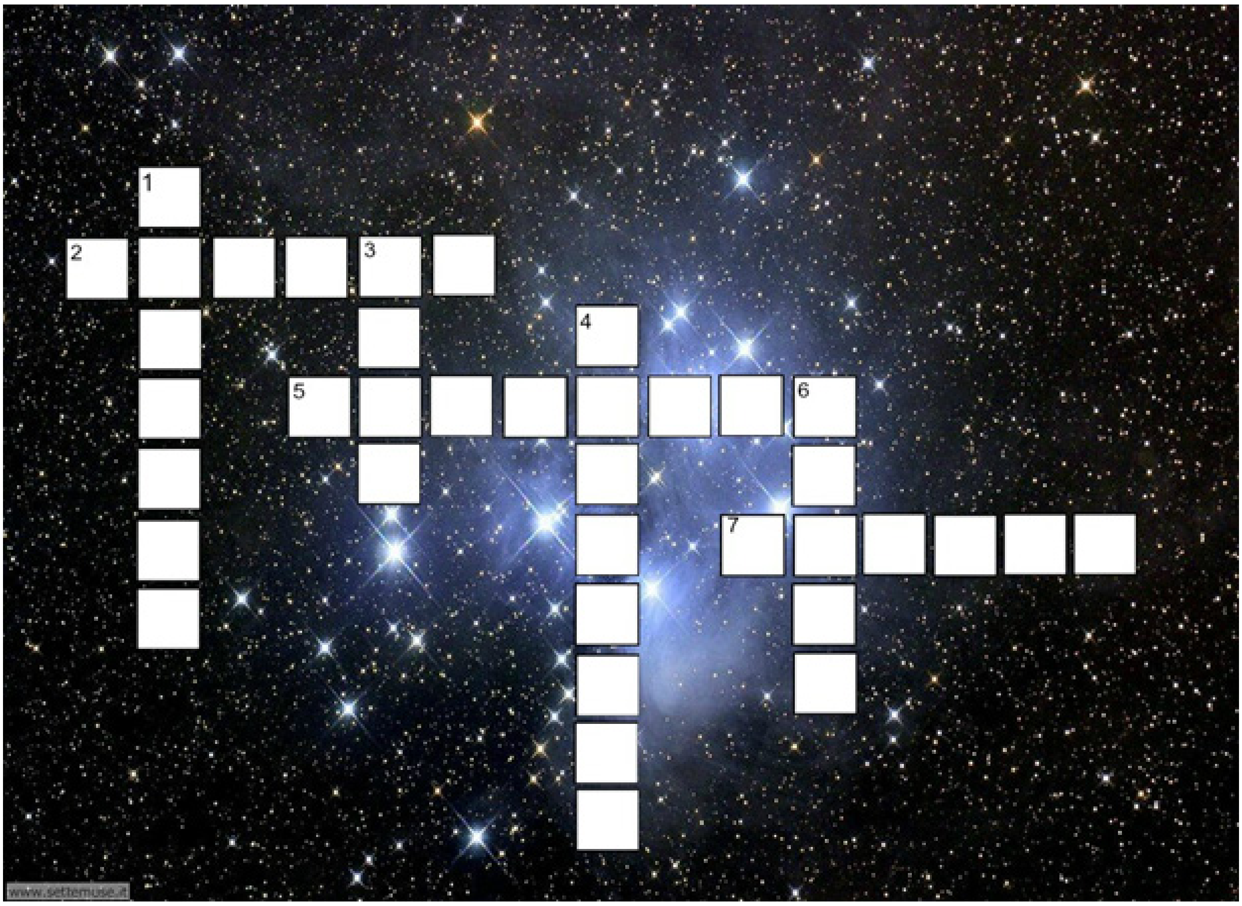




FUN PAGE

Wordcross

by Edoardo Lo Presti



1) Which process is stopped by chemotherapy?
2) Ag in the Periodic Table.
3) What are the organs of visual sense?
4) Not mammal Animals, as fish, birds and reptilians.
5) It is one of the potential dangerous Italian volcano.
6) A constellation is made by …
7) Milky Way is our ...

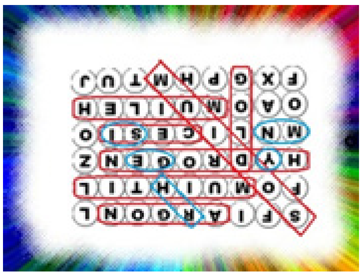
1) Mitosis
2) Silver
3) Eyes
4) Oviparus
5) Vesuvius
6) Stars
7) Galaxy

FUN PAGE

WordCage

by Edoardo Lo Presti

Are you able to find the names of the elements below?
Li, H, Ar, Na, Cs, Au, He
And are you able to find the symbols of Manganese, Silicon, Germanium, Rhodium and Yttrium?



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The Sicily earthquake of January 11th 1693

Terremoto 11 Gennaio 1693 nella Sicilia orientale

Introduction

Sicily is almost entirely seismic area, and over the centuries until today there have been many earthquakes, some very powerful and dangerous others of lesser intensity. In 1693 there was one of the most devastating earthquakes in the last 1,000 years, as for the damage caused and the number of casualties, and one of the most destructive earthquakes of the Italian seismic history.

The earthquake affected in almost whole Sicily but it particularly hit the southeast coast of the island causing enormous damage and gaining the name of "earthquake of the Noto valley"

Objective

To find out the rate of damage caused by the 1693 earthquake, and the techniques available today to deal with an earthquake.

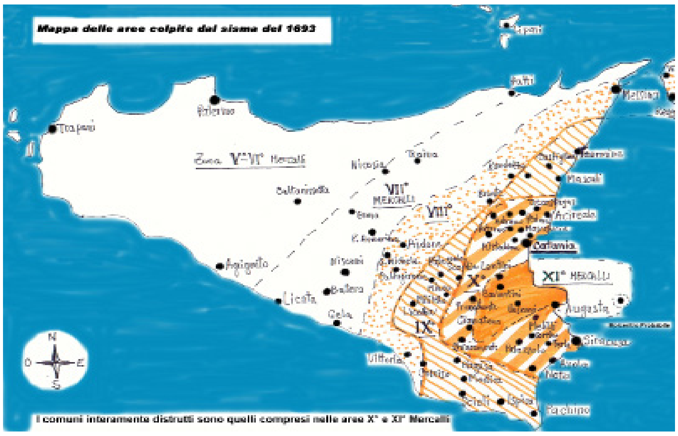


Fig. 1. Map of areas affected by the 1693 earthquake

Fig. 1. Mappa delle zone colpite dal terremoto del 1693

Results

The earthquake strucked a vast territory, in a violent form, hitting the south-eastern Sicily with two powerful shocks occurred in two days' time. The first earthquake was on 9th January 1693 with an intensity that reached 8-9 degrees on the Mercalli scale. The damage was serious

Introduzione

La Sicilia è quasi interamente una zona sismica e, nel corso degli anni, fino ad oggi i terremoti sono stati parecchi, alcuni molto potenti e pericolosi altri di minore intensità. Nel 1693 la Sicilia fu colpita da uno dei terremoti più forti che si sia mai verificato nel corso degli ultimi 1.000 anni e, per il danno fatto e per le numerose perdite di vite umane, è uno dei terremoti più distruttivi della storia sismica italiana. Il terremoto interessò quasi tutta la Sicilia, ma la costa sud-est dell'isola è stata coinvolta in modo particolare, ed è stato proprio in questa zona che sono stati riscontrati più danni e per questo prese il nome di "terremoto del Val di Noto ".

Obiettivo

Capire quanti danni si sono riscontrati con il terremoto del 1693, e vedere che tecniche abbiamo oggi per affrontare un terremoto di alta intesità.

Risultati

Il terremoto ha colpito un vasto territorio, ed è apparso in una forma violenta, colpendo la Sicilia sud-orientale, con due potenti scosse registrate alla distanza di due giorni. La prima scossa è stata il 9 gennaio 1693, con un'intensità che ha raggiunto 8-9 gradi della scala Mercalli. Il danno fu molto grave in città come Augusta, Avola, Noto (l'attuale Noto Antica), Floridia, Melilli, dove molti edifici crollarono. Gravi danni ed il crollo di palazzi interessò anche Catania e Lentini. Molti palazzi e case, nonché chiese e monumenti, a Catania, già gravemente danneggiate dall'eruzione distruttivo del 1669, andarono distrutti provocando la morte di numerose persone. A Siracusa molti edifici furono danneggiati, ma il danno complessivo era meno grave rispetto a Catania. La scossa è stata avvertita con forza, ma senza danni, a Messina e Malta, e significativamente fino a Palermo.

in cities such as Augusta, Avola, Noto (the present Ancient Noto), Floridia, Melilli, where many buildings collapsed. Serious damage and collapse also affected Catania and Lentini. Many buildings and houses as well as churches and monuments, in Catania, already seriously damaged by the destructive eruption of 1669, suffered widespread damage, some private houses collapsed, killing 16 people. In Syracuse more buildings were damaged, some were in danger, but overall damage was less severe than in Catania. The quake was intensity high, but without damage, in Messina and Malta, and significantly up in Palermo. The second shock came after two days on 11th January 1693 and was more powerful, causing catastrophic effects. The enormous severity of these effects was also due to the overlapping of two shocks. Moreover the area affected by the second earthquake was much larger than the previous one, so many villages, that had escaped the violence of the first earthquake, suffered major damage or a total collapse. Suffice it to say that the most severely damage area extended over a vast area of over 14,000 square kilometers, which was completely devastated. The entire eastern Sicily was seriously affected. Collapse and severe damage occurred to Messina and to the Tyrrhenian coast to the north, and up to Malta to the south. Widespread and significant damage was found in Reggio Calabria, Agrigento and even in Palermo, located more than 150 km from the epicenter. Lighter damage occurred to the Aeolian Islands and in some centers of the villages and southern Calabria. The strongest effects, however, were those of the tsunami. The quake on 11th January caused tsunami waves that swept several resorts on the east coast of Sicily, from Messina to Syracuse. The most severe effects occurred at Augusta, where the tsunami wave reached the height of 30 cubits (about 15 meters) damaging the galleys of the Knights of Malta and the flooding of the city overlooking the harbor in Catania. The sea first retired from the beach for a few tens of meters, dragging some boats anchored near the shore. Then, it hit back the coast violently, with 2 meter high waves, which flooded inland up to Piazza San Filippo (currently Piazza Mazzini).

The seismic period was very long, in fact,

La seconda scossa arrivò dopo due giorni ovvero l'11 gennaio 1693 e delle due fu la più potente, causando danni veramente catastrofici. L'enorme gravità di questi effetti si sovrappose con quelli della scossa del 9 gennaio. È anche vero che l'area interessata fu molto più grande di quella colpita dal primo terremoto, tanto che molti luoghi che furono stati solo leggermente, o per niente, danneggiati il 9 gennaio, vennero distrutti completamente. Basti dire che l'unica area più danneggiata si estendeva su una vasta area di oltre 14.000 chilometri quadrati, che fu completamente devastato. Tutta la Sicilia orientale è stata seriamente compromessa. Gravi danni si sono verificati da Messina e dalla costa tirrenica, fino a Malta. Danni diffusi ma di poca significatività sono stati registrati a Reggio Calabria, Agrigento e anche a Palermo, nonostante l'epicentro fosse a più di 150 km di distanza. Danni più leggeri si verificarono nelle Isole Eolie e in alcuni centri della Calabria centrale e meridionale. Gli effetti più forti, però, sono stati dovuti al successivo tsunami. Il sisma dell'11 gennaio, infatti, generò onde di tsunami che spazzarono via diversi villaggi sulla costa orientale della Sicilia, da Messina a Siracusa. Gli effetti più gravi si sono verificati ad Augusta, dove l'onda dello tsunami raggiunse l'altezza di 30 cubiti (circa 15 metri) danneggiando la galera dei Cavalieri di Malta e l'allagamento della città con vista sul porto. A Catania, il mare prima si ritirò dalla spiaggia per alcune decine di metri trascinando alcune barche ancorate vicino alla riva, poi si è riversato violentemente sulla costa con onde alte 2 metri che arrivarono in città fino a Piazza San Filippo (l'attuale piazza Mazzini).

Fig. 2. **Catania damage of the 1693 earthquake**

for more than three years there were numerous shocks, and some of strong intensity that almost broke down of the few survivors, and some preferred to leave the city rather than facing future shocks. The enormous disaster caused by this earthquake, also implied change in the reconstruction of some villages; total changes were not many, because they required the consent of the Viceroy in charge at that time.

The severity of such devastation was due to the characteristic of the buildings, which were totally unsafe and to the lack of anti-seismic building technique. Some progress took place in the mid-700s, in fact, after the earthquake that destroyed many cities Sicilian, the main objective was to build more solid and safe buildings. Nowadays striking progress has been made buildings are more and more resistant buildings to earthquakes, many techniques and procedures and have adopted to as save many lives as possible in case of earthquake. The fundamental criterion of earthquake-resistant buildings is to create structure that allow you to save human lives, while sacrifyi the structural benefits. In this case the resistant structure of the building, designed with the following criteria (in associated to a high structural ductility), may (and should) deform considerably out hanks to a wide range or elasticity, to reinforced concrete; the building may also undergo to partial collapse, but must, however, always be designed to avoid, or at least delay, the total collapse, in order to allow the escape of those who live there. You accept this kind of compromise, which is part of conventional seismic building techniques. To create a building that can withstand resist damage to an earthquakes it is almost impossible, as well as economically unsustainable. It is the determination of the appropriate level of safety, depending on the intended use and degree of foreseeable danger using probabilistic methods.

After presenting a theoretical model on which to base the design, they can be used various methods to minimize damage can be used including:

- Decrease in the mass of the building
- adoption of stiffening cores as baffles, ele-

Il periodo sismico è stato molto lungo; infatti, per più di tre anni ci sono state numerose scosse, di cui alcune di forte intensità, che hanno messo alla prova la resistenza dei pochi sopravvissuti. Per questo molti di loro hanno preferito andare via dalla città, piuttosto che rimanere nelle proprie abitazioni in preda alla paura.

L'enorme disastro provocato da questo terremoto, porta anche al cambiamento nella ricostruzione di alcuni villaggi; spesso modifiche totali non erano consentite, perché queste ultime richiedevano il consenso del viceré in carica in quel momento. Purtroppo, tutto questo è accaduto perché in passato non erano presenti le stesse tecniche che abbiamo oggi per affrontare un terremoto, come anche la struttura degli edifici (circa 1600-1700), e quindi questo significava mettere a repentaglio la vita di ogni persona. Qualche progresso si ebbe intorno alla metà del '700; infatti, dopo che questo terrificante evento, l'obiettivo principale era quello di costruire edifici più solidi e sicuri. Al giorno d'oggi sono stati fatti progressi sorprendenti nella costruzione di edifici sempre più resistenti ai terremoti, e sono state adottate molte tecniche e procedure per salvare quante più vite possibile in caso di terremoto. Uno dei criteri fondamentali per la costruzione di edifici antisismici è quello di produrre opere che consentano di salvare sempre più vite umane. In questo caso la struttura resistente dell'edificio, progettato con gli adatti criteri (in combinazione con una elevata duttilità strutturale), potrebbe (e dovrebbe) deformarsi notevolmente, così come le strutture portanti del cemento armato. L'edificio potrebbe anche essere soggetto al collasso parziale; tuttavia deve poter ritardare il crollo totale, per consentire la fuga di chi ci vive.

Si accetta questo tipo di compromesso con le tecniche convenzionali sismiche, al fine di creare un edificio in grado di sopportare, almeno in parte, i danni provocati dal terremoto. È la determinazione del livello di sicurezza appropriato, a seconda della destinazione d'uso e il grado di pericolo prevedibili con metodi probabilistici.

Dopo aver presentato un modello teorico su cui basare il progetto di costruzione possono essere utilizzati vari metodi per minimizzare i danni, tra cui:

vator shafts, stairwells, which tend to absorb the horizontal actions being rigidly connected to the rest of the structure. Structural masses are distributed with particular care and, at the design stage, the need is for careful checks.

• Adoption of the criterion of the hierarchy of strength: it studies the structure so that the plastic hinges are formed in the beams before the pillars (strong pillar - weak beam) so that the collapse mechanism is activated after the formation of many hinges plastics;

• Careful design of structural problems, namely the unions between beams and columns with appropriate buttresses;

• Use of so-called chains to enhance the strength of the structure;

• adoption of seismic dampers: devices made with materials of "sacrifice" that are placed in locations subject to high strain, for example in structural joints, attenuating the movements and eventually arriving at break, in order to preserve the structural integrity. They can be subsequently replaced.

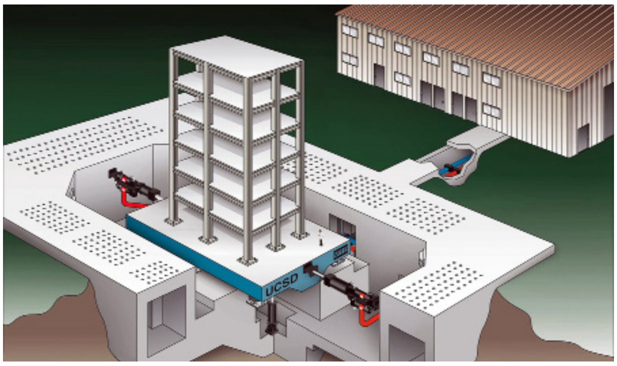


Fig. 3. Modern seismic methods
Fig. 3. Tecniche antisismiche moderne

These are just a few techniques that you can use, but the most important thing to prevent disasters such as those of 1693 is to perform of prevention operation in all the cities; prevention is not difficult: avoid building in areas where the seismic risk is very high.

Conclusions

We have seen how nowadays there are many techniques to deal with an earthquake and then avoid the emergence of catastrophes such as those of 1693 which killed thousands of civilians.

• Diminuzione della massa dell'edificio;

• adozione di irrigidimento nuclei come deflettori, pozzi degli ascensori, scale, che tendono ad assorbire le azioni orizzontali rigidamente collegate al resto della struttura, masse strutturali sono distribuite con particolare cura e, in fase di progettazione, la necessità è per accurati controlli;

• L'adozione del criterio della gerarchia di forza: studia la struttura in modo che le cerniere plastiche si formano nelle travi prima pilastri (solido pilastro - raggio debole) in modo che il meccanismo di collasso è attivata dopo la formazione di molte cerniere plastiche;

• L'accurata progettazione dei problemi strutturali, cioè le unioni tra travi e colonne con contrafforti adeguate;

• uso delle cosiddette catene per aumentare la resistenza della struttura;

• l'adozione di ammortizzatori sismici: dispositivi realizzati con materiali di "sacrificio" che sono collocati in luoghi soggetti a forti sollecitazioni, ad esempio nei giunti strutturali, attenuanti i movimenti e alla fine arrivano a rottura, al fine di preservare l'integrità strutturale. Essi possono essere successivamente sostituiti.

Queste sono solo alcune tecniche che è possibile utilizzare, ma la cosa più importante per prevenire disastri come quelli del 1693 è necessario eseguire il lavoro di prevenzione in tutte le città. Fare prevenzione non è difficile; per esempio, evitare di costruire in zone in cui il rischio sismico è molto alto.

Conclusioni

Abbiamo visto come al giorno d'oggi ci sono molte tecniche per prevenire gli effetti di un terremoto e quindi evitare l'emergere di catastrofi come quelle del 1693 che ha ucciso migliaia di civili. Si deve dire che in quel periodo non si conoscevano le moderne tecniche di cui beneficiamo oggi e la catastrofe, per un terremoto di tale intensità, era inevitabile.

Nonostante tutto, questo tragico evento ci ha aiutato a guardare avanti, di apprendere nuove tecniche utilizzate oggi per affrontare un terremoto.

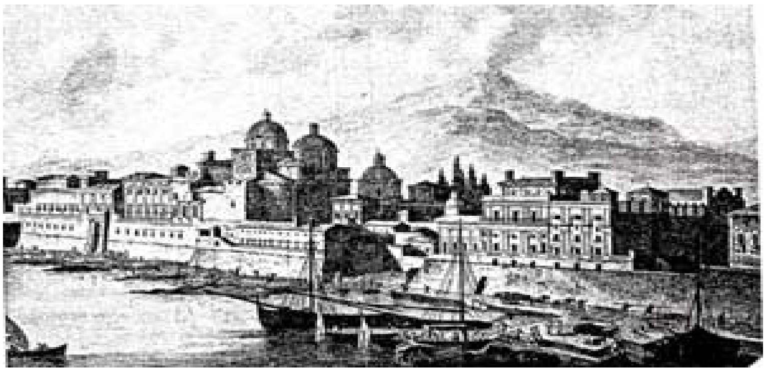
It must be said that then you do not know the modern techniques of which we benefit and then the catastrophe, an earthquake of that intensity, it was inevitable; despite all this tragic event helped us to look forward, to learn new techniques used today to face an earthquake.

Iconography

https://i.ytimg.com/vi/KnTTuHPkaOw/maxresdefault.jpg

https://upload.wikimedia.org/wikipedia/commons/7/77/Sicilia_Sisma_1693.jpg

http://lavocedeisenzavoce.altervista.org/wp-content/uploads/2016/11/a6.jpg



Bibliography

Archivio Storico Eoliano

http://www.archiviostoricoeoliano.it/wiki/il-terremoto-del-1693

Ultima TV

http://www.ultimatv.it/2017/01/11/terremoto-e-tsunami-324-anni-fa-lapocalisse-su-catania-e-val-di-noto/

Meteo Web

http://www.meteoweb.eu/2016/01/accade-oggi-nel-1693-il-terremoto-che-distrusse-catania-e-che-uccise-piu-di-30-mila-persone/612267/

Edil Portale

http://www.edilportale.com/news/2016/09/focus/soluzioni-antisismiche-per-la-progettazione-degli-edifici_54085_67.html

Ilfatto Quotidiano.it

http://www.ilfattoquotidiano.it/2015/01/11/terremoti-se-sistema-antisismico-700-tiene-quelli-moderni/1331304/

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The Intensity of Earthquakes in History

Introduction

Lately, we have heard about Earthquakes in Italy, causimg serious damages in a large area. That happens sometimes because the Italian anti-seismic standards for build-rights are not often respected.

Earthquakes are generated by movements of the Earth caused by tectonic forces acting consistently within the Earth's crust, producing the release of energy in an inner portion of a giver hypocenter. Observing the fracture, you can be noticed that the propagation waves, elastic waves or seismic waves spread in all directions. The area of the Earth's surface located on the vertical hypocenter is called epicentre. The geophysics branch which studies these phenomena is Seismology.

Methods

I searched the Net looking for information about several scientific sites in the history of Earthquakes and analyzed the topics in order to draw the most important things to be able to understand the most effective contributions. My research takes in consideration several websites, but I went to look at scientific journals, only.

Results

A first attempt to indicate the intensity of a Earthquake is due to the Italian seismologist and volcanologist G. Mercalli that, in 1900, devised a scale based on the observation of the effects of an Earthquake on buildings, people and environment, defining 10 degrees linked to the severity of the damage. Later, the effects of a Earthquake were to be referred to a modified Mercalli scale, which included 12 degrees linked to shock records by seismographs only, regardless of no damage to buildings or persons. Grade 12, however, means a great catastrophe and the total buildings destruction. In each area affected by seismic movements, the Earthquake is given a degree of intensity, the highest at the hypocentre and decreasing in the areas far from it and the epicentre.

L'Intensità dei Terremoti nella Storia

Introduzione

In questi ultimi anni sono stati molti i terremoti che hanno colpito l'Italia, causando gravi danni alle nostre città. Queste catastrofi, anche letali, provocano timore in Italia in quanto le strutture adeguate per le norme anti-sismiche non sempre sono rispettate. Un terremoto (o sisma) viene generato da movimenti della terra o per assestamenti. Ma cos'è, in realtà, il terremoto? In geofisica i terremoti, detti anche sismi o scosse telluriche, sono vibrazioni o assestamenti improvvisi della crosta terrestre, provocati dallo spostamento improvviso di una massa rocciosa nel sottosuolo. Harry Reid, un sismologo americano, elaborò la teoria del rimbalzo elastico: esso considera la massa rocciosa interessata dall'evento sismico caratterizzata da un comportamento elastico in seguito a deformazione per effetto di una sollecitazione come avviene nel caso di una molla: in seguito a rottura dell'equilibrio meccanico e al brusco ritorno delle masse rocciose a una nuova condizione di equilibrio permanente, l'energia elastica accumulata durante la deformazione si libera in parte sotto forma di calore per attrito lungo la superficie della faglia, in parte sotto forma di energia cinetica cioè violente vibrazioni o oscillazioni della crosta terrestre nel punto di rottura. Per epicentro si intende quel punto della superfi-

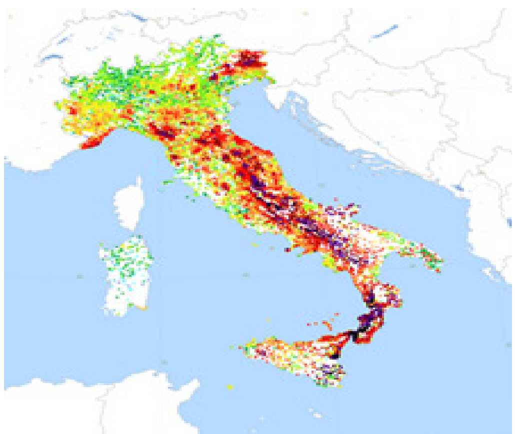

Fig. 1. **Earthquakes in the Italy to the 1900 at 2000**
Terremoti in Italia dal 1900 al 2000

The well known Richter scale estimates the Magnitude of the maximum amplitude recorded by a seismometer, using instruments able to measuring even the smallest movements of the ground. This scale consequently is a quantitative one, that measures physical characteristics of the Earthquake. Unlike the scale of intensity, the Richter Magnitude is a continuous one, that is the values recorded by two different unit Earthquakes, even they may also differ by just one tenth. The Magnitude of a instrumentally recorded event may be calculated by many ways, depending by different characteristics of the seismogram (height of the maximum peak, signal duration, etc.). Besides, every event depending by the Magnitude, is often assessed with regard to the maximum acceleration of the ground. It should be noted, in any case, that the peak accelerations are able to only partially describe the dangerousness of the Earthquake; in fact, of extreme importance are not only energy from it altogether developed and the maximum values of the motion of the ground, but also the extent to which the seismic energy is associated to the different frequencies, given equivalent overall seismic energies. Anyway, the seismic risk is different if such energy is associated with frequencies far from those which characterize the buildings, or if it occur, for example, coincident with these frequencies.

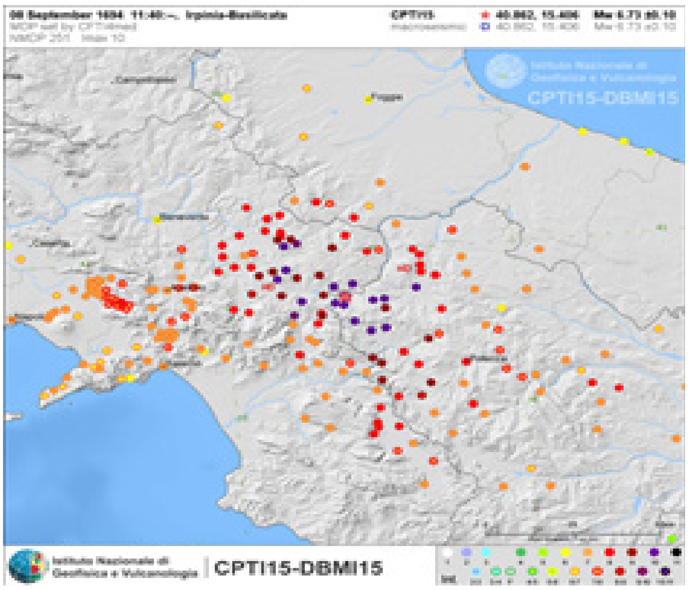

Fig. 2. **Earthquakes in centre Italy**
Fig. 2. Terremoti centro Italia

cie terrestre posto esattamente sopra l'ipocentro (che è il punto nel quale ha avuto origine il terremoto al di sotto della crosta terrestre).

Scopo di lavoro

Un primo tentativo per indicare l'intensità di un terremoto è dovuto al sismologo italiano e vulcanologo Giuseppe Mercalli, il quale intorno al 1900 mise a punto una scala di valutazione (Scala di Mercalli, detta anche "Scala Mercalli-Cancani-Sieberg" in onore dei tre sismologi che hanno ampliato e migliorato il grado di valutazione della scala) basata sull'osservazione degli effetti di un terremoto su edifici, persone e ambiente, diviso in 12 gradi a seconda della forza del terremoto: partendo dal primo grado, ovvero piccolissimi ed impercettibili movimenti e scosse, fino ad arrivare a catastrofi come l'ultimo grado, il dodicesimo. Charles Richter, fisico e sismologo statunitense, il quale ha dato il nome alla famosa scala sismica che misura la magnitudo di un terremoto, detta "scala Richter", rivela, a differenza della scala di Mercalli, l'energia che il terremoto sprigiona. Tale operazione è stata poi ampliata grazie al sismografo, che è uno strumento in grado di misurare anche i più piccoli movimenti del terreno, costituito da una serie di elementi che consentono la rappresentazione grafica dell'andamento del segnale sismometrico nel tempo sotto forma di un sismogramma. Analizzando il sismogramma si può conoscere l'entità, la natura e la distanza del sisma dal punto dove è avvenuta la registrazione del sismogramma stesso.
Il sismografo deve dunque rappresentare fedelmente il movimento del suolo oppure le grandezze (accelerazione o velocità) con le quali si può in seguito estrapolare il movimento assoluto del suolo. Questa scala è quindi una scala quantitativa che misura le caratteristiche fisiche del sisma. La grandezza di un terremoto può essere registrata strumentalmente poiché può essere calcolata in vari modi, dalle diverse caratteristiche del sismogramma (altezza del picco massimo, durata del segnale, ecc.). La scala Richter consente di valutare con precisione l'intensità dei terremoti che si verificano in zone desertiche, o il cui epicentro si trova

Conclusion

The Richter scale allows you to accurately assess the intensity of the Earthquakes that occur in desert areas, or those epicentres located on the seabed, which would be impossible to evaluate with the Mercalli scale, simply because in these areas there were no effects on buildings and people.

There is no connection among intensity measured by Mercalli scale and Magnitude, since the surface Earthquakes that occur in densely populated areas can produce much more damage of the same Magnitude Earthquakes occur in desert areas or very deep hypocenter. Earthquakes, in the past as well today, cannot be predicted, but the prevention is possible and due. A step forward would be to significantly enhance Earthquake-resistant buildings (as in Japan) that are able to hold the stormy movement of Earthquakes causing at last the drop of some home objects, rather than bring down an entire home or, even worse, an entire building with dozens of families.

Iconography:

centro meteo, http://www.centrometeo.com/articoli-reportage-approfondimenti/geologia-vulcanologia-sismologia/5435-misura-terremoti-mercalli-richter

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sul fondo del mare, che sarebbe impossibile con la scala Mercalli che misura l'intensità basandosi sui danni ai manufatti e sulla percezione umana soggettiva del fenomeno sismico (e che dipende dunque anche dalla distanza del centro colpito dall'epicentro del sisma, e dalle caratteristiche dell'edilizia della regione). Non vi è alcuna corrispondenza tra l'intensità misurata con la scala Mercalli e la grandezza, dal momento che i terremoti superficiali che si verificano in aree densamente popolate possono produrre danni molto di più degli stessi terremoti di magnitudo che si verificano in zone desertiche.

I terremoti, in passato come anche oggi, non si possono prevedere, ma si può cercare di prevenire come ad esempio non costruendo in zone sismiche n futuro l'obiettivo sarebbe quello di creare edifici antisismici (come in Giappone) che sono in grado di sostenere scosse di intensità sempre più forte.

Bibliografia:

INGVterremoti ,Dante Mariotti, https://ingvterremoti.wordpress.com/category/i-terremoti-nella-storia/

http://www.protezionecivile.gov.it/jcms/it/glossario.wp?contentId=GLO13263

http://www.astrogeo.va.it/sismologia/sismi.php

Catalogue of strong earthquackes, http://storing.ingv.it/cfti4med/quakes/01166.html

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History of Volcanology

I.Previous knowledges

The volcano is a fracture of the earth's crust from which emerge different types of lava, gas, debris, etc ..., which sometimes emerge from a true conical structure (such as Etna, Vesuvius, Stromboli, etc ...), while in other cases, from the linear fractures (as mid-ocean ridges). Volcanology is the science dealing with the study of volcanoes, and more generally, of all volcanic phenomena related to it and employees.

While the volcano is a real structure, volcanism is the set of phenomena related endogenous activity of magma, etc ..., that causes the volcanic phenomena.

The history of volcanology, embracing together science and history, myth and legend, is the set of theories that have developed between the various historical periods, which have led to the current development of volcanology.

II.Objectives

The objective of this scientific report is to know to learn the history of volcanology, considerations of "volcano" and volcanism in different historical periods (Since the pre-classical age, up to more recent times). Although the volcano and volcanic activity are already very discussed subjects in the past, what are the theories, thoughts (more or less scientific) that are rooted in the common belief and the scientific community? What are therefore the roots behind the scenes of the volcano, which produce the effects that we all know?

III.Materials

The materials that I have used for the preparation of the report was taken by academic books, official publications and from an interview made to volcanologist Dr. Stefano Branca, in Osservatorio Etneo of Catania (INGV - Department of Catania).

IV. Preclassic Age

Opposite to a natural frightening show, the primitive man could not find a rational explana-

Le "Quinte" Vulcaniche

I.Conoscenze pregresse

Sappiamo essere, il vulcano, una frattura della crosta terreste dalla quale fuoriescono diverse tipologie di lave, gas, detriti, ecc. …, che in alcuni casi erompono da una struttura conica vera e propria (come l'Etna, il Vesuvio, lo Stromboli, ecc. …), mentre in altri casi, da delle fratture lineari (come le dorsali). Proprio la vulcanologia è la scienza che tratta lo studio dei vulcani, e più in generale, di tutti i fenomeni vulcanici ad esso correlati e dipendenti.

Mentre il vulcano è la struttura vera e propria, il vulcanismo è l'insieme dei fenomeni vulcanici riconducibili all'attività endogena dei magmi, ecc. …

La storia della vulcanologia, che abbraccia scienza e storia, mito e leggenda, è l'insieme delle teorie sviluppatesi che tra i vari periodi storici, che hanno portato allo sviluppo attuale della vulcanologia.

II.Obiettivi

L'obiettivo della presente relazione scientifica è quella di conoscere la storia della vulcanologia, attraverso le considerazioni di vulcano, e di vulcanismo nelle varie epoche storiche. Questa relazione ha una duplice finalità, poiché non si riduce esclusivamente ad uno scopo didattico, ma mi permette un'esplorazione nei meandri storici che conduce ad una visione critica globale della storia del vulcanesimo in tutte le sue sfaccettature. Pertanto, se il vulcano ed il vulcanismo, sono concetti già molto discussi nel passato, quali sono le teorie, i pensieri (più o meno scientifici che siano) che si sono radicati nella credenza comune e nella comunità scientifica? Quali sono, pertanto, "i protagonisti dietro le quinte del vulcano", che producono gli effetti che tutti conosciamo?

III.Materiale

Il materiale che ho utilizzato per la stesura della relazione, e per lo studio della stessa, è stato reperito, data la scarsità di siti scientifici online, prevalentemente da libri unition to volcanic activity, and represented this as a terrible monster, a demon, that needed to appease with sacrifice and prayers. According to a lot of historical sources, despite the enormous distance between the people, it was believed that the volcano is demonic and destructive... where lived fantastic creatures (in South America was a monstrous whale, in India was a big mole or ferocious boar, in Japan was a frightening spider, in Indonesia was a snake with a fiery venom. From 1492, after the discovery of American continent, whereas the European myths have been modified by new or later cultures, the most important testimonials in Preclassic Age of volcano's development and of volcanism have been by native Americans. The amazing thing is that in these myths there are a lot of similarities among past and modern eruptions.

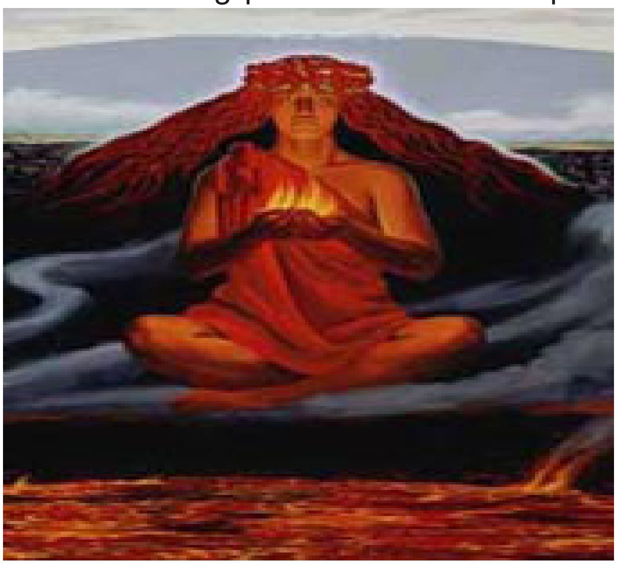


Fig. 1. **Mythologic representation of volcano Pelèe's Goddess**
Rappresentazione mitologica della Dea del vulcano Pelèe

V. **Greek Age**

- **The pre-platonic myths**

In the Greek age, the Greek people began a collection of information, that comes from an observation more accurate of natural elements around volcano, especially around the volcanoes Thera and Etna.

The most ancient volcanologic Greek document is represented by Pindar's odes, that describes Etna during the amazing eruption of 479 B.C. Probably this first description has been helpful for the successive explanation of volcanic's processes with the mythology. So, the myth

versitari e pubblicazioni ufficiali, oltre che, da un'intervista fatta al vulcanologo Dott. Stefano Branca, presso l'Osservatorio Etneo di Catania (INGV- Sezione di Catania).

IV. Età Preclassica

Di fronte ad uno spettacolo naturale sconvolgente, l'uomo primitivo, incapace di trovare una spiegazione razionale all'attività vulcanica, la raffigurava come un terribile mostro, un demone, di cui bisognava placare la tremenda ira con sacrifici e preghiere. Secondo numerose fonti storiche, nonostante le enormi distanze esistenti tra un popolo ed un altro, quasi la totalità dei popoli antichi possedeva una concezione di vulcano demoniaca e distruttrice.

Di conseguenza l'origine dei vulcani, seppur ancora non studiata, faceva riferimenti a miti e leggende di creature fantastiche. Nei popoli sudamericani, ad esempio, si supponeva che il vulcano eruttasse per la crudeltà di una mostruosa balena (gli sbuffi d'acqua del mammifero, erano associati al fumo che usciva dal vulcano), in India questa figura era raffigurata come una gigantesca talpa o un feroce cinghiale, nell'arcipelago nipponico come un ragno spaventoso, in Indonesia come un serpente dal veleno infuocato. Dal 1492, dopo la scoperta del continente americano, poiché i miti europei più antichi sono stati successivamente cancellati, modificati, influenzati dalle stratificazioni culturali successive, alcune delle più importanti testimonianze sullo sviluppo di un vulcano e sul vulcanismo ci sono date dalle culture dei nativi americani, venuti a contatto con la civiltà europea in epoca tarda. La cosa che più sorprende, è che questi miti posseggono numerose affinità con eruzioni recenti avvenute nella stessa area, come nel caso dell'eruzione del Saint Helens nel 1980.

V. Età Greca

- **I miti pre-platonici**

Nell'età classica, a partire dal periodo greco, si cominciò ad avviare una raccolta di informazioni, che, seppur ancora spiegate attraverso la mitologia, partivano da un'osservazione più accurata della realtà, la quale traeva spunto da elementi naturali disseminati attorno al Vulcano, specialmente attorno i vulcani Thera ed Etna.

of volcano's god Hephaestus (known as the God of fire), the myths of Cyclopes (Bronte, Sterope, Arge e Polyphemus), the myths of Titans, explained in the Hesiod's Theogony, will be born.

 Pyriflegheton and the Pneumatic Theory

Plato hypothesized that inside the Earth existed a river of fire, the "Pyriflegheton", that freed air causing Earthquake and volcanic eruptions. The Plato's idea gave a great development to volcanology, and this doesn't appear to us much far from reality.

Aristotle, instead, is inspired by an idea of Anaxagoras, that suggested a more rational explanation, that is based on wavy motion, that compresses the air and forced-it to infiltrate and go-around inside the Earth, whereafter the reacting, and the next contact with sulfur and bitumen, causes smokes, slags, ashes and flames. All this, according new studies, is originated by the effect of the wind on the ember. Therefore, the description of first bellow signed an incredible turning, because the volcanology from holy science became profane science.

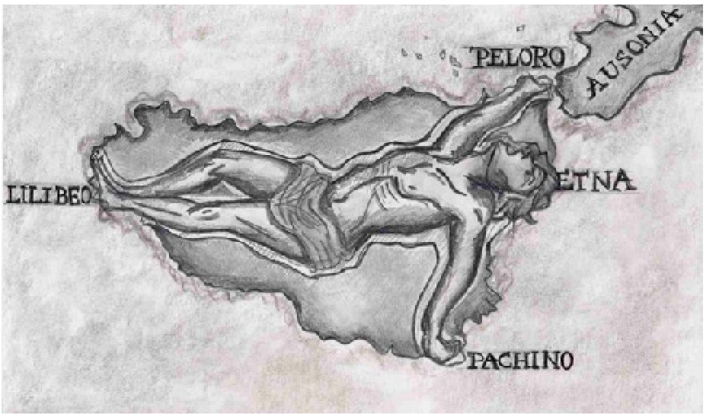


Fig. 2. **Representation of giant Typhon, responsible of volcanism of Etna according ancient Greek culture**

Rappresentazione del gigante Tifeo, responsabile del vulcanismo etneo, secondo la cultura dell'Antica Grecia

VI. Roman Age

 First Roman Age

The Romans took references from Aeolian Islands, from "Campania Felix" (around Naples), and from Etna. In Punic Wars 'Age, the noise coming from volcanic bowels, is interpreted by Romans as impetuous hammer blows of God Volcano (Volcano's God, such as Hephaestus. However, the Romans, learned

Nella fattispecie, il documento vulcanologico più antico è rappresentato dall'ode poetica di Pindaro, nella quale, pur parlando del gigante Tifeo, il vulcano Etna viene definito come "la colonna del cielo dalle quali bocche fuoriescono colate ardenti che si riversano sui fianchi del monte". Probabilmente questa prima breve descrizione (eruzione etnea del 479 a.C.), è stata funzionale per la spiegazione successiva dei processi vulcanici con la mitologia. Così sarebbero nati sia i miti dei Ciclopi (Bronte, Sterope, Arge e Polifemo)che, forgiando il metallo nelle caverne del vulcano insieme ad Efeso (Dio Vulcano), avrebbero formato i numerosi coni avventizi disseminati sui fianchi dell'Etna, oltre che dei Faraglioni, gettati dai Ciclopi contro Ulisse nel racconto dell'Odissea scritta da Omero, sia anche i miti dei Titani, raccontati da Esiodo nella Teogonia, che tentarono di schiacciare gli dei dell'Olimpo, ma sconfitti da Giove, furono seppelliti vivi dal crollo delle montagne, lanciando fumo e fiamme delle loro fauci. Tutto ciò testimonia una prima mitologica spiegazione dei fenomeni vulcanici.

 Pyriflegheton e la Teoria Pneumatica.

Successivamente, il grande filosofo greco Platone, ipotizzò che all'interno della terra esistesse un fiume di fuoco, il "Pyriflegheton", dal quale si liberava aria causando così terremoti ed eruzioni vulcaniche. L'intuizione di Platone diede uno sviluppo possente alla vulcanologia, e a distanza di secoli, non appare poi tanto lontana dalla realtà la sua teoria, se si paragona il Pyriflegheton al magma, e l'aria ai gas in esso racchiusi.

Aristotele, invece, riprendendo una convinzione poco conosciuta di Anassagora, suggerì una spiegazione apparentemente più razionale, la quale si basava sul moto ondoso delle onde del mare. Quando, infatti, in un'area cavernosa, le onde comprimevano l'aria, la costringevano ad infiltrarsi e a circolare all'interno della terra. Lì, in seguito al riscaldamento, e al successivo contatto zolfo e bitume, ne provocavano l'incendio, formando ceneri, fumo, scorie e fiamme, liberate poi attraverso i condotti vulcanici. La spiegazione aristotelica dell'attività vulcanica trae forse origine, secondo alcuni recenti studi, dall'effetto del soffio to know the dangerousness of Volcano and venture on this, in specific period or Seasons.

Augustan Age

During Augustan Age, a lot of scientists decided to change Volcanoes ‘myths with scientific theory, with the observation of nature. The first to have done this, was Strabo, that took in his “Rerum Geo-Graphicarum”a very accurate description of natural elements and events. From it, we can, for example, understand the shapes, the dimensions, the activities of Etna in Augusta Age, and for this is reputed a fundamental text.

Moreover, Strabo was the first person to know

the volcanic nature of Vesuvius, discovering the “burned” rocks. Strabo had announced the eruption, and for this was preoccupied, because on the scopes there were a lot of big cities, although he didn’t know the dimension of the tragedy. After half century from his death, the catastrophic eruption of 79 A.D., that destroyed Pompeii, Herculaneum, Stabiae, etc…, confirmed the Strabo’s idea. Strabo opened the street to scientific research, but was stopped by the decline of Roman Empire, and Christian’s conceptions.

Fig. 3. **Volcano in Roman mythology**
Vulcano nella mitologia romana

del vento sulla brace che la rende più ardente. Se ciò fosse vero, l’invenzione del primo mantice segna una svolta incredibile nel cammino dell’umanità, poiché la vulcanologia da scienza sacra diventa profana. Questa teoria pneumatica dominò per ben due millenni il pensiero scientifico, dando prova dell’inerzia del pensiero e del peso di un nome autorevole, nell’età immediatamente successiva, rappresentando un punto cardine a cui si rifaranno numerosi filosofi dell’età tardo repubblicana, come Lucrezio.

VI. L’età Romana

Dai miti di Vulcano all’osservazione diretta

La mentalità dei Romani era dedita maggiormente all’atto pratico e all’osservazione, rispetto ai greci. Essi traevano i maggiori riferimenti dalle isole Eolie, dall’area campana e dall’Etna. Nell’era delle guerre puniche, non conoscendo ancora gli scritti aristotelici, i rumori provenienti dalle viscere vulcaniche venivano interpretati come violentissimi colpi di martello del dio Vulcano (rinominazione del dio greco Efeso), poiché ancora, senza uno sviluppo scientifico imponente, la gente colmava con l’immaginazione le lacune che non era in grado di integrare e verificare con i dati scientifici. Tuttavia, i romani, impararono a riconoscere le pericolosità di un vulcano, e ad avventurarsi su di essi, in periodi ben precisi, grazie anche alla gente locale, che faceva da cicerone lungo i versanti.

Gli studi di Strabone

Altri studiosi decisero di sostituire al mito una teoria più plausibile, attraverso l’osservazione della natura. Il primo a fare ciò, fu il greco, naturalizzato romano, Strabone, che raccolse nella sua opera “Geografia” una descrizione molto accurata dei fenomeni naturali. Egli narra che la cima dell’Etna cambiava spesso forma a causa di un fuoco sotterrane, che la rompeva da una o più aperture con lunghe colate miste a fumo, fiamme e massi incandescenti. In effetti, guardando l’Etna negli ultimi anni, si comprende come la fisionomia del vulcano sia continuamente cambiata, proprio come Strabone definiva in età augustea.

Degno di nota è lo spirito di osservazione eccezionale di Strabone che lo porto a riconoscere la natura vulcanica del Vesuvio, prima di tutti gli altri , scoprendo le rocce “bruciate” lungo i

Fig. 6. **Procession in honor of Saint Agatha for stop ping an eruption of Etna**
Processione in onore di Sant'Agata per fermare un'eruzione dell'Etna

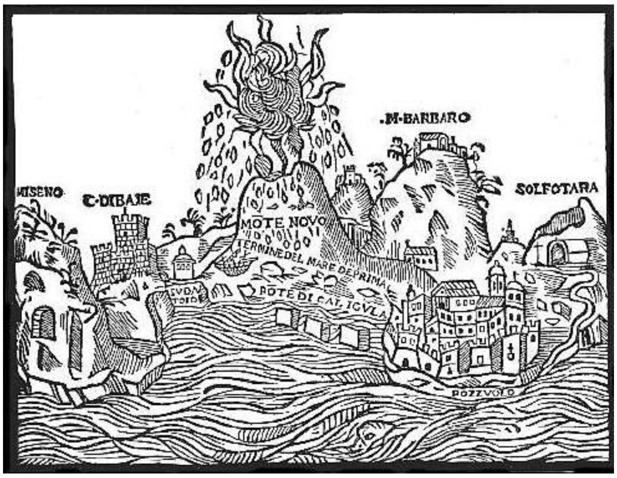


Fig. 7. **Eruption of Monte Nuovo (Pozzuoli,1538)**
Eruzione del Monte Nuovo (Pozzuoli, 1538)

VII. Late Roman Age and Middle One

In Imperial Age, pneumatic hypothesis of Aristotle reigned in aristocratic classes, thanks Seneca, but in Late Roman Age, the people, especially, after the conception of Cassius Dio and Saint Augustine, was resumed the mythology, where Volcano became the Devil. For example, in Sicily and Campania, to put an end to lava flows, that was wanted by Devil, from VI century, the people initiated to pray the Saints and God.

Only thanks the Arabians of Spain, independent by Christian traditions, we have known some very accurate news of past eruptions in Canary Islands, such as those of Strabo.

VIII. Modern Age

 The dogmatic imposition of 16th CenturyIn 1538, the birth of a new volcano, the "Monte Nuovo", near Pozzuoli, aroused the curiosity of the world. It was the first time that this phenomenon could be seen from the beginning.

versanti. Poiché, il Vesuvio, che fino a quel momento era stato quiescente e non costituiva una minaccia per i romani, era circondato da importanti città come Stabia, Pompei ed Ercolano, Strabone era preoccupato all'idea di un eventuale eruzione, di cui certamente sconosceva le dimensioni. Dopo mezzo secolo dalla sua morte, come egli temeva, la terribile eruzione del 79 d.C. che devastò la Campania e causò la morte di un altro famoso vulcanologo, Plinio il Vecchio. Così, Dopo Plinio il Vecchio, il compito di descrivere l'eruzione toccò al nipote Plinio il Giovane, che lo farà in maniera così dettagliata che questa narrazione fu utilizzata in seguito dai vulcanologi moderni per la comprensione dei meccanismi con la quale l'eruzione era avvenuta, coniando il termine "eruzione pliniana". È, però, da notare, come sia Strabone, sia Plinio il Vecchio, sia Plinio il Giovane, fossero ancora molto influenzati dalla mitologia greca e romana. Tuttavia, resta il merito di questi grandi naturalisti, che, sostituendo alla speculazione astratta, all'osservazione diretta della natura, aprirono la via alla vera ricerca scientifica, la quale, però, avrà vita breve, poiché ostacolata dalla decadenza dell'Impero Romano. Proprio nell'ultimo periodo imperiale Dione Cassio, ritornerà a parlare del Vesuvio, come fucina degli dei, taverna del fuoco, e prigione dei dannati, fornendo una base alla quale la credenza cristiana si appigliò.

VII. L'età medioevale

Dopo l'avvento della filosofia scolastica, che disprezzava l'osservazione della natura ritenendola inutile e dannosa (in quanto fonte di idee diaboliche), l'ipotesi pneumatica di Aristotele regnò sovrana per molti secoli, grazie al contributo filosofico di Seneca, che riprese le teorie aristoteliche, aggiungendovi, però, la combustione interna dello zolfo e l'evaporazione dell'acqua, i quali producevano insieme i fumi tossici. Tuttavia, se la teoria pneumatica ridivenne celebre tra l'aristocrazia medievale, il popolo, specialmente dopo le concezioni di Dione Cassio e Sant'Agostino, considerò i vulcani come l'anticamera dell'inferno, con il dio Vulcano tramutato in Diavolo. Allo scopo di porre fine alle colate vulcaniche volute dal Diavolo, dal VI secolo d. C., si iniziarono in Sicilia e in Campania ad invocare i Santi.

While the people thought of a God's scourge, the scientists, linked to dogmatism, tried to explain the eruption with the Aristotelian theory. In 1546, starting from this eruption, the German Georg Pawer, wrote the first treatise of mineral deposits "De Ortu et Causis Subterraneorum", where the volcanic activity is also explained. According his theory, the subterranean steam burns the rock soaked of water, determining an enormous force that breaks everything near the surface, founding there vent.

Fig. 8. **Portrait of René Descartes**
Ritratto di Renato Cartesio

IX.The 17th and 18th Century

From '600, the studies of volcanology were concentrated by scientists to the source of heat that nourished Volcanoes.

The cooled star

Edward Jorden in 1632 wanted to put an end to scientific tradition of combustion in Volcanoes, because according to him, to maintain the fire inside, the volcano would need air to sustain the combustion, so an enormous opening on top should exist to offer a constant flow of air."

For this, in1644, René Descartes, in his "Principia Philosophiae", talking about Earth's origin, he supposed that it was initially an incandescent body, such as the sun, that was cooled by heat conduction. So Descartes defined the energetic source of volcanism, and also the Earth's origin, representing a fundamental theory for the future of science. This theory became famous at the start of 1700s, thanks to Leibniz, and especially in XX Century with geologists Hutton, Lyell and Suess.

The exothermic theory of fire

Despite Cartesian theory, appears al-

L'introduzione del concetto cristiano di colpa, pertanto, reintroduce la visione dell'evento naturale catastrofico come punizione divina, e le processioni per l'espirazione dei peccati, supportati dalla Chiesa Cristiana, diventarono la prassi comune in occasione di eventi vulcanici. Solamente grazie agli arabi di Spagna, che si manterranno lontani dalle tradizioni cristiane, ci sono pervenute alcune notizie di eruzioni avvenute nelle Isole Canarie, molto dettagliate come quelle di Strabone, che cercheranno, riprendendo idealmente Seneca, di verificare il ruolo dello zolfo nelle reazioni vulcaniche.

VIII. L'età moderna

L'imposizione dogmatica del '500

Dopo la lunga notte medievale, nel 1538 la nascita di un nuovo vulcano, il Monte Nuovo, presso Pozzuoli, destò la curiosità di gran parte del mondo. Era la prima volta infatti che tale fenomeno poteva essere seguito nelle sue varie fasi fin dall'inizio. Anche in questo caso, tra il popolo, ci fu chi gridò al miracolo, chi ad un flagello di Dio (da reindirizzare all'eruzione del 79 d.C.), e chi infine lo considerò opera del diavolo. Gli scienziati, invece, ancora saldamente legati al dogmatismo tentano di spiegare l'eruzione con la teoria pneumatica di Aristotele che regnava ancora indiscussa.

Nel 1546, partendo da questa eruzione, il tedesco Giorgio Agricola (Georg Pawer) scrisse il trattato sui giacimenti minerari De Ortu et Causis Subterraneorum nel quale viene spiegata l'attività vulcanica. Secondo la sua teoria il vapore, che si forma a causa del calore sotterraneo che brucia le rocce imbibite d'acqua, possiede una forza tale da rompere qualsiasi cosa nelle immediate prossimità della superficie, trovandovene lì sfogo.

IX. Il Seicento e il Settecento:

Tra '600 e '700 i principali scienziati che si occupavano dei vulcani e del vulcanismo si basarono principalmente su due teorie molto diverse fra loro. Una si basava sul calore e sulle fiamme emesse dalle reazioni esotermiche all'interno del vulcano, l'altra faceva risalire il vulcanismo alla condizione terrestre di una stella in via di raffreddamento.

La teoria chimica del "fuoco" vulcanico

most real, in late ‘600, the principal theory was that of Isaac Newton, in 1692, which had formulated some ideas on Earth’s heat and its intensity, starting from a series of exothermic reactions, that developed under pressure, an intense heat and a flame.

X.Contemporary Age

The develop of exothermic theory of Davy and Day

In ‘1800, with the scientific development in Physics and Chemistry, the exothermic reactions between the water and the metals (Sodium, Potassium and Calcium) were studied for explaining the volcanism with a return to exothermic theory of Newton. Humphrey Davy, after discovering the chemical and physical properties of alkali metals, was convinced that the heat developed during the redox reactions of alkali metals was the source of the heat of volcanism, supposing the existence of big amount of alkali metals under volcanic regions, even a lot of scientists such as Gustav Bischof or L. J. Gay-Lussac criticized this theory. Gay-Lussac, had demonstrated the impossibility for the atmospheric air to enter volcano’s interior, for the high pressure and the high density of the magmatic fluid acted with a contrary motion in respect to the normal motion’s air; therefore, air couldn’t flow in volcanic system against this big pressure gradient.

The Moon’s effect of Ampere, and the “Star Theory” of Hopkins-Kelvin

Influenced by Descartes, after the critique of Gay-Lussac, the scientist thought that the primeval heat of Earth maintained, during its formations, was linked to a fluid inside the Earth. Nevertheless, according to some studies, realized by Ampere on the tides, and the effects of attraction of Sun and Moon, in 1833, the existence of only fluid inside was excluded.

From 1839 to 1842 William Hopkins and his student William Thomson Lord Kelvin, thanks to some studies, emptied the Ampere’s theory. In fact, after the analysis of effects of Moon and Sun on Earth’s rotation axis, they concluded that there is an external rigid layer (until 1500 km), a soft layer (until 2900 km), and a liquid layer, (after 2900km); it isn’t accidental that the zone around 2900 km will be

Col progredire delle ricerche scientifiche, lo studio dei fenomeni vulcanici si concentrò sulla fonte di calore che alimentava i vulcani, quale, cioè l’origine dell’energia del vulcanismo, che poco era spiegata dalla teoria aristotelica. Numerosi scienziati si cimentarono nello studio del calore, ma la teoria più convincente all’epoca (seppur partita e migliorata rispetto ad altre teorie precedenti), fu quella di Isaac Newton, nel 1692, che aveva formulato opinioni sull’origine del calore della Terra e sulla sua intensità, partendo da una serie di reazioni altamente esotermiche, che riuscivano a sviluppare sotto una relativa piccola pressione un calore intenso ed una fiamma molto violenta.

La Stella di Raffreddamento

Nonostante numerosi studiosi, indicassero oltre allo zolfo , al bitume, al carbone e alla pirite (bisolfuro di ferro), come possibili elementi che producevano il “fuoco”, dalla quale deriva il vulcanismo vulcanico, lo scienziato Edward Jorden volle porre fine (anche se con poco successo) alla secolare tradizione scientifica della combustione nei vulcani, poiché essi necessiterebbero di un flusso incessante d’aria così enorme, che per mantenere vivo questo “fuoco”, servirebbero aperture megalitiche per far entrare l’aria.

Il francese René Descartes (Renato Cartesio), nella sua opera Principia Philosophiae, parlando dell’origine della terra, suppose che essa fosse stata inizialmente un corpo incandescente, simile al sole, raffreddatasi per semplice conduzione. In questo modo Cartesio definì non solo la fonte energetica del vulcanismo ed il calore interno, ma anche l’origine stessa del pianeta, rappresentando una delle teorie fondamentali per lo sviluppo della futura vulcanologia, geologia, ecc... Successivamente anche Leibniz, si associò a questa ipotesi, facendola ridiventare celebre non solo all’inizio del 1700, ma anche oltre, infatti divenne una corrente di pensiero che ritroverà la notorietà nel secolo XX, specialmente grazie ai geologi Hutton, Lyell e Suess.

X.L’età Contemporanea

Lo sviluppo della Teoria chimica di Davy e Day

Nell’Ottocento, inoltre, parallelamente, con il notevole progresso scientifico nel campo della chimica e della fisica, furono chiamate nuo-

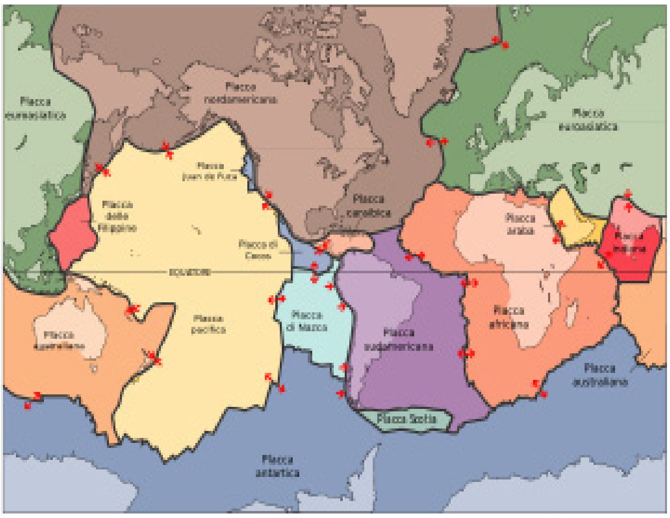


Fig. 9. **Map of plates**
Mappa delle placche

Gutenberg's discontinuity. Moreover, they verified the existence of liquid materials, before 1500 km, exclusively in limited underground reservoirs, which form many "underground lakes".

A. Wegener and the theory of continental drift

In 1912 Alfred Wegener formulated the Theory of Continental Drift, starting from other past scientist's idea, who proposed the movement of continents. This movement, would developed an enormous heat, that would been at the bases of volcanism. This theory was declared absurd, because there were not experimental evidences.

Holmes and the convective cells

In 1929, along with the scientist Vening-Meinesz, starting from Wegener's model, Arthur Holmes tried to define the forces that caused the continental drift. He was convinced that the tensions necessary for fracturing the earth's "crust" were generated by convective motions, caused from inner different temperature and density. Such flows are formed below the SiAl (lithosphere), in the SiMa, for the high hydrostatic pressure, that increase the viscosity and the rigidity of the underlying fluid material, causing consequently the rupture of the crust and the displacement of the continents. However, this model was incomplete and, because based on Wegener's model, received a few attentions, despite represented the first theory that provides a unified explanation of principal characters of the Earth, the surface and mantle.

vamente in causa le reazioni esotermiche fra l'acqua e i metalli (sodio, potassio, calcio e ferro), come possibile causa del vulcanismo, con un ritorno alla teoria chimica precedente. Un'ipotesi nuova e influente sulla chimica esotermica fu sviluppata da Humphry Davy, dopo l'isolamento dei metalli alcalini, e la scoperta delle loro proprietà chimiche e fisiche. Davy era convinto che il calore sprigionato durante l'ossidazione degli elementi alcalini fosse la fonte di calore dei fenomeni vulcanici, supponendo l'esistenza di grandi quantità di alcalini metallici all'interno della terra sotto le regioni vulcaniche. A questa teoria, però, numerose critiche seguirono, come quella fatta dal tedesco Gustav Bischof e dal francese L. J. Gay-Lussac, che aveva dimostrato l'impossibilità per l'aria atmosferica di entrare in profondità dei vulcani, perché l'alta pressione e l'alta densità del liquido magmatico agisce con un moto contrario a quello ipotetico dell'aria, e pertanto, questa non poteva fluire nel sistema vulcanico e alimentare le reazioni contro un tale gradiente di pressione. Nonostante i numerosi addebiti, la teoria chimica di vulcanismo è stata sorprendentemente ripresa da eminenti scienziati come Arthur L. Day (l'ultimo dei sostenitori della teoria chimica, nel 1925), quando propose che le reazione chimiche tra gas portano alla fusione locale e alla generazione di magma.

L'effetto della Luna di Ampère, e la teoria "stellare" di Hopkins e Lord Kelvin

Influenzati dalle idee di Cartesio, il calore all'interno della Terra era dagli studiosi considerato un residuo del calore primitivo "tenuto" dalla Terra al momento della sua formazione. Inoltre, secondo gli studi sulle maree e sugli effetti dell'attrazione del Sole e della Luna, Ampère nel 1833, sottolineò l'impossibilità di un interno totalmente fluido.

Dal 1839 al 1842, tuttavia, William Hopkins, e il suo allievo William Thomson Lord Kelvin ridimensionarono la teoria di Ampère e di Cartesio, infatti ,dopo aver analizzato gli effetti della Luna e del Sole sull'asse di rotazione della Terra, conclusero che la crosta rigida esterna deve essere di almeno 1500 km di spessore, e che la materia fluida esiste entro questa misura in serbatoi sotterranei di limitata misura, formando tanti laghi sotterranei, e non un oceano sotterraneo unito, il quale, tuttavia, si trova esclusivamente nel nu-

Fig. 11. **Portrait of A. Rittmann**
Ritratto di A. Rittmann.

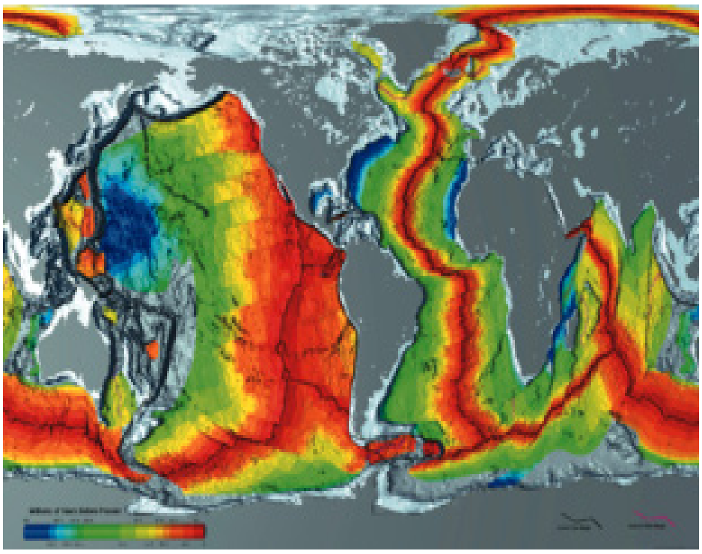


Fig. 12. **Age of Earth seafloor crust, 1996**
Età del fondale marino terrestre, 1996

Rittmann and the rapid decompression

Alfred Rittmann tried to define a new theory starting from Holmes's one. According to him, when some cause determine the disruption of gravitational, hydrostatic, thermal, physic-chemical or static equilibrium within the SiMa, the base of crust, for its plasticity, suffers very strong tensions 'till to fracture. The fracture allows, for a rapid decompression, the separation of volatile components (before in solution in the magma under high pressure), increasing of volume until the vapor pressure becomes greater that pressure, and causes the spill of material from fracture, that feeds the volcano (for Rittmann, this is the principal cause of volcanism). This theory was criticized by scientists, because there weren't evidences supporting the thesis.

cleo a profondità di oltre 2900 km (misura identificata poi con la Discontinuità di Gutemberg).

L'impulso di A. Wegener e la Teoria della Deriva dei Continenti

Nel 1912 Alfred Wegener formulò la teoria della deriva dei continenti, che suppose il movimento di grandi zattere galleggianti della crosta, definite placche. Secondo la sua teoria, da questi movimenti (anche se non vengono spiegati come essi avvengono), si sarebbe sviluppato un calore enorme, forse causa principale del vulcanismo. Questa teoria fu stata dichiarata assurda, poiché, non v'erano evidenze sperimentali, o prove scientifiche. Nonostante, questo apparente insuccesso, la teoria di Wegener, attivò, tuttavia, un collegamento senza precedenti tra molti aspetti diversi della geologia, che erano stati precedentemente considerati indipendenti e non correlati alla vulcanologia.

Holmes e le celle convettive litosferiche

Nel 1910 il geologo britannico Arthur Holmes, dopo la scoperta della radioattività, ha iniziato uno studio della radioattività naturale delle rocce, che lo portò nel 1929, insieme allo studioso Vening-Meinesz, partendo dal modello di Wegener, alla convinzione che le tensioni necessarie alla fratturazione della crosta terrestre fossero generate da correnti di convezione che si formano al di sotto della litosfera (nel Sima, parte intermedia della Terra) a causa delle alte pressioni idrostatiche, che aumentano la viscosità e la rigidità dei magmi sottostanti, provocando di conseguenza, in seguito alla rottura della crosta, lo spostamento dei continenti.

L'idea che il manto subisca convezione termica si basa sul principio fisico per il quale l'aumento di temperatura comporta la diminuzione della sua densità, inducendo la risalita verso la superficie, finché la temperatura non diminuisce, causando un riaffondamento nel Sima, e una frequente attività sismica e vulcanica.

Tuttavia, questo teoria poiché non spiegò le vere cause del vulcanismo, e, come, questo magma potesse risalire, sia perché basata sul modello di Wegener, ricevette ben poca attenzione dal mondo scientifico, al momento della sua pubblicazione.

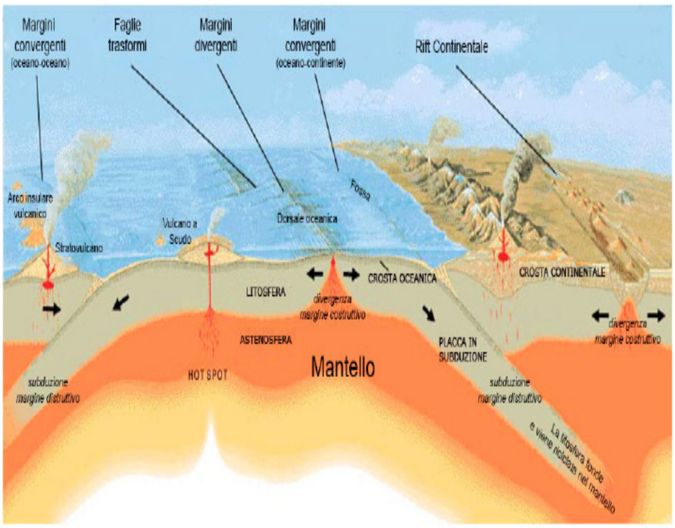
Hess-Deitz ‘model and the mid-ocean ridge

Until 1960, Holmes‘s idea wasn’t considered. However, a greater understanding of seabed, and the discover of mid-ocean ridge, with their anomalies, have brought Harry Hess and Robert Deitzto to publish a theory, based on convective motions in the mantle, for explaining the expansion of seabed and volcanic phenomena, that derive from them, known as a “Sea-floor spreading”. The fundamental idea was the same of 30 years before with Holmes; However with, the increase of scientific evidences and the mapping of earthquakes and volcanoes, this theory was accepted by scientific world, and replaced the earlier models.

The Plumes and Hotspots

After the publication of “Sea-floor spreading”, the first contradictions and the first exceptions emerged, because many regions did not fall in the general framework. For example Hawaii Islands, are very far from north-American plate‘s border, but they have a lot of active volcanoes.

J. Tuzo Wilson in 1963 hypothesized that Hawaii Islands arise on Hotspot. Only after 8 years, in 1971, W. Jason Morgan for explaining the exceptions published “Hotspots theory” that represents the base of current volcanology. Morgan proposed the “mantle plumes”, that were described as hot jets climbing from deep mantle, near the outer core and Gutemberg‘s discontinuity. This feed the volcanoes, as in Hawaii or Iceland. In some point, in the years, this theory was changed, but in major part, it is overall the



Rittmann e la decompressione dei magmi

Ripartendo dagli errori e dalle critiche del modello di Holmes, Vening-Meinesz e Wegener, il vulcanologo svizzero, direttore dell’Istituto di Vulcanologia dell’Università degli Studi di Catania, Alfred Rittmann, provò a definire la chiave di volta del vulcanismo. Secondo la sua teoria, ogni volta che qualche causa determina la rottura dell’equilibrio gravitativo, idrostatico, termico, fisico-chimico o isostatico all’interno del Sima, la base della crosta, a causa della sua viscosità, subisce tensioni molto forti fino a fratturarsi. La frattura appena creatasi permette, attraverso una rapida decompressione, la separazione dei componenti volatili (prima in soluzione nel magma a causa della forte pressione), aumentando di volume, finché la tensione di vapore diventa maggiore della pressione, e, quindi, provocano una fuoriuscita del materiale dalla frattura, che alimenta così il vulcano. Tale svolgimento dei gas della massa magmatica è considerata, pertanto, la causa principale del vulcanismo. Anche questa teoria, tuttavia, fu molto criticata dal mondo scientifico, e scartata, poiché non vi erano molte prove a supporto della tesi.

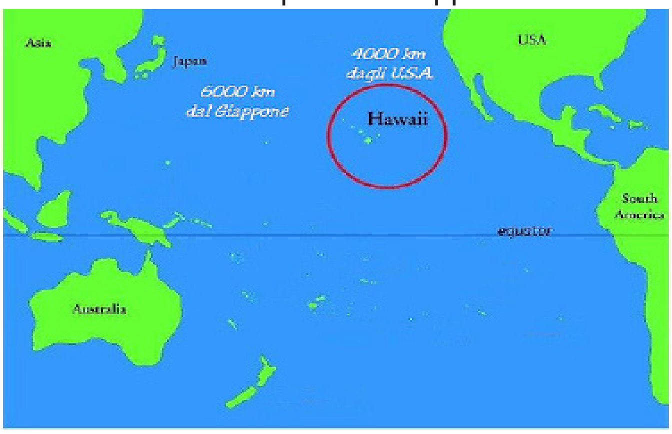


Fig. 12. **Distance of Hawaii from the coasts**
Distanza delle Hawaii dalla costa

Il modello di Hess-Deitz e le dorsali oceaniche

Fino al 1960 l’idea di Holmes non ricevette alcuna attenzione. Tuttavia, una maggiore comprensione del fondo marino e le scoperte delle dorsali oceaniche, con le loro anomalie geomagnetiche, l’associazione con gli archi insulari e le fosse oceaniche in prossimità dei margini continentali, hanno portato Harry Hess e Robert Deitz a pubblicare una teoria basata sulle same. Now, this is the principal theory among geologists and volcanologists, but there are a lot of forcing and for this, a lot of scientists are trying to find new explanations and evidences.

Other Theories

There exist some more theories. According to one of them, the rocks inside the Earth would be fused by radiogenic heat, produced by Uranium, Thorium or Potassium. According other, the Earth's heat derives from natural nuclear reactors in Earth's core. There are so fanciful hypothesis of impact of meteorites formed by antimatter, as that formulated by Urey.

XI.Conclusions

Through this report, I have arrived to understand the many steps that volcanology has crossed to get to the considerations and current theories, based for now in the theory of plates and plumes, which currently, and is fundamental to specify currently, it is the theory that more than all the other ones, explains the volcanism. We all have, and we know today about volcanoes, volcanic processes, etc ..., we owe it through centuries of studies by scientists that is also thanks to absurd assumptions; they have enabled the development of volcanology. In fact, if in past ages volcanologists have often ignored the causes of melting processes that bring to formations of magma, making the volcanology a descriptive discipline at the edge of science. Now modern volcanology is the science that studies the production of magma, its transport, the surface processes of magma's evolution and the eruptions.

Bibliography

- F. Stoppa, Il Vulcanesimo. La preistoria: Le origini del mito, Atti del convegno 13-14 Maggio 2009, Roma, 2009
- H. Sigurdsson , The History of Volcanology, Graduate School of Oceanography, University of Rhode Island, Narragansett (RI, USA),
- H. Sigurdsson , Bruce F. Houghton , Stephen R. McNutt, Hazel Rymer, John Stix, Encyclopedia of Volcanoes, Academic Press, 2000
- R. Scandone, L. Giacomelli, Vulcanologia, Liguori editore, Napoli 2002
- M. Cortini, R. Scandone, Un introduzione alla Vulcanologia, Liguori Editore, Cercola (Napoli), 1987

correnti convettive del mantello per spiegare l'espansione dei fondali oceanici e i fenomeni vulcanici che da essi ne derivano, nota come "Sea-floor spreading". Questa idea era fondamentalmente la stessa di quella proposta da Holmes più di 30 anni prima, con l'aggiunta di prove scientifiche (in quel periodo venne fatta la mappatura dei terremoti e dei vulcani, che rimarcavano proprio quei margini di quelle che saranno poi chiamate placche) che sostituiranno definitivamente i modelli precedenti per riaffermare sia la teoria di Holmes, ma soprattutto quella di Rittmann, venne considerato da quel momento, il padre della vulcanologia.

I Plumes e gli Hotspots

Quando, sia la teoria delle placche, sia quella della deriva dei continenti furono accettate, cominciarono ad emergere le prime contraddizioni e le prime eccezioni, poiché molte regioni non rientravano nel quadro generale.

Ad esempio le isole Hawaii, sono distanti migliaia di chilometri dal margine della placca nordamericana, eppure esse possiedono alcuni tra i vulcani più attivi e alti al mondo.

J. Tuzo Wilson nel 1963 ipotizzò, allora, che le isole Hawaii sorgessero su una regione calda del mantello, sulla quale giace attualmente la placca pacifica. Solo, però otto anni più tardi, nel 1971, W. Jason Morgan, pubblicherà la teoria degli Hot spots (Punti Caldi), che rappresenterà il seme da cui si svilupperà la vulcanologia degli ultimi anni, e che permetterà di spiegare ulteriormente decine di vulcanismi insoliti. Morgan nella sua teoria propose I "mantle plumes", cioè i pennacchi del mantello, essi vengono descritti come degli zampilli caldi, che risalgono dalla zona profonda del mantello

confinante con il nucleo esterno della Terra, intorno alla discontinuità di Gutenberg (strato D). A causa della spinta idrostatica dovuta alla loro minore densità alimentano sacche di magma vicino alla superficie, definite Hotspots. Queste, a loro volta, alimentano il vulcanismo di zone vulcaniche come le Hawaii o l'Islanda. A questa teoria, attualmente in auge tra i geologi e i vul

canologi, sono andati a incrociarsi in seguito altre teorie di altri scienziati, che man mano ne hanno migliorato il contenuto, anche mettendo in luce le criticità che

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• Marco Segala, La favola della terra mobile. La controversia sulla teoria della deriva dei continenti, Bologna, 1990

Iconography

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• https://upload.wikimedia.org/wikipedia/commons/thumb/e/ed/Strabo.jpg/220px-Strabo.jpg
potrait of Strabo - Ritratto di Strabone
• www.fucinemute.it/wp-content/uploads/2013/06/gigante-02.jpg
portrait of Renè Descartes - Ritratto di Renato Cartesio
• www.ct.ingv.it/rittmann2014/images/stories/rittmann.jpg
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• www.settemuse.it/pittori_scultori_italiani/

vanno in contraddizione con gli elementi della teoria della deriva dei continenti.

Altre Teorie

Secondo varie ipotesi vulcanologiche, le rocce all'interno della terra sarebbero fuse dal calore radiogenico, prodotto dall'uranio, dal torio e dal potassio. Altre teorie, invece, prenderebbero in considerazione bombe atomiche, reattori nucleari naturali intraterrestri, fino ad ipotesi fantascientifiche di impatti di meteoriti formati da antimateria, come formulato negli anni 60 dal chimico Harold Urey. Egli sostenne l'Accretion Theory, ovvero quella teoria che fa derivare l'origine dei pianeti dall' agglomerazione di meteoriti. Questa teoria fu accettata da molti astronomi e geofisici, mentre fu, ed è tutt'ora contestata dai vulcanologi in quanto essa non spiega in maniera soddisfacente l'origine dell'energia e le modalità energetiche del vulcanismo.

XI.Conclusione

Attraverso questa relazione, sviluppata in ambito storico-scientifico, ho compreso i numerosi passaggi che la vulcanologia ha attraversato per arrivare alle considerazioni ed alle teorie attuali, radicate da qualche decennio nella teoria delle placche e in quella dei plumes, che attualmente sono le teorie che più di tutte le altre spiegano i fenomeni vulcanici e il vulcanismo. Bisogna considerare come, tutto ciò che conosciamo oggi sui vulcani e sui suoi processi lo dobbiamo a secoli di studi da parte di scienziati, che, se pur azzardando ipotesi assurde, hanno permesso lo sviluppo della vulcanologia. Infatti, se in epoche passate, i vulcanologi hanno spesso ignorato le cause dei processi di fusione che portano alla formazione del magma, facendo diventare la vulcanologia una disciplina descrittiva, priva di rigore, al margine della scienza, adesso la vulcanologia moderna è la scienza che si occupa dello studio della produzione di magma, del suo trasporto, dei processi superficiali dell'evoluzione e dei processi eruttivi.

Bibliography

• F. Stoppa, Il Vulcanesimo. La preistoria: Le origini del mito, Atti del convegno 13-14 Maggio 2009, Roma, 2009
• H. Sigurdsson , The History of Volcan-

giordano/luca_giordano_020_la_forgia_di_vulcano.jpg
(The Volcano's Forge - La Forgia di Volcano
• https://upload.wikimedia.org/wikipedia/commons/f/f5/Earth_seafloor_crust_age_1996_-2.png
Age of Earth seafloorcrust, 1996 - Età del fondale marino terrestre, 1996)
• https://blueteamscience.files.wordpress.com/2014/06/seafloor.jpg
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volcanoes, and more generally, of all volcanic phenomena related to it and employees.
While the volcano is a real structure, volcanism is the set of phenomena related endogenous activity of magma, etc ..., that causes the volcanic phenomena.
The history of volcanology, embracing together science and history, myth and legend, is the set of theories that have developed between the various historical periods, which have led to the current development of volcanology.
 Pyriflegheton and the Pneumatic Theory
Plato hypothesized that inside the Earth existed a river of fire, the "Pyriflegheton", that freed air causing Earthquake and volcanic eruptions. The

Fig. 13. **An example of explosive volcanism**
Un esempio di vulcanismo esplosivo

ology, Graduate School of Oceanography, University of Rhode Island, Narragansett (RI, USA),
• H. Sigurdsson , Bruce F. Houghton , Stephen R. McNutt, Hazel Rymer, John Stix, Encyclopedia of Volcanoes, Academic Press, 2000
• R. Scandone, L. Giacomelli, Vulcanologia, Liguori editore, Napoli 2002
• M. Cortini, R. Scandone, Un introduzione alla Vulcanologia, Liguori Editore, Cercola (Napoli), 1987
• P.Kearey, K.A.Klepeis, F.J.Vine, Global Tectonics, Wiley-Blackwell Press, Oxford,2009
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(Mythologicrepresentation of volcanoPelèe'sGoddess - Rappresentazione mitologica della Dea del vulcano Pelèe)
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Space and Solar System Evolution

Introduction

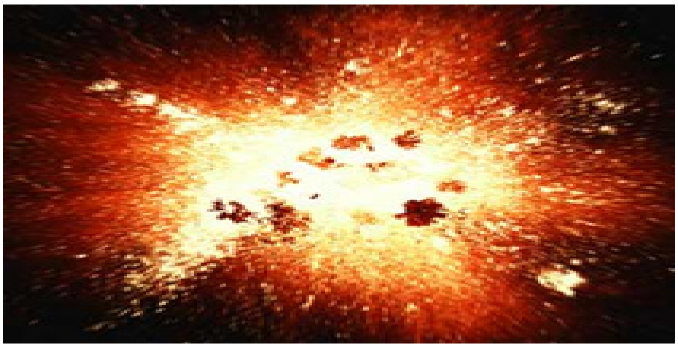
Science has generated several hypotheses about how the universe originated. Throughout history myths, especially by primitive peoples have been created. The most accepted theory about the formation of the universe is that of Bing Bang by George Gamow. There is on other theory, but there isn't any evidence of it. The age assumed for the universe is 13.28 billion years and the years of solar system are 4.5 billion. The future of the universe is a slow expansion; the end of the solar system is expected to be due to the sun. The sun will exhaust the hydrogen that powers it and shut down. There are many philosophical theories, some of them foresee say the death and rebirth of the universe. The universe is a collection of matter, energy, galaxies, planets, stars and systems including the solar system. The big bang theory is confirmed by astronomical observations and these allow us to say that the big bang phenomenon is still active. With the passage of the time three theories on the shape of the universe: were formulated:

1. Closed universe, which will collapse.
2. Stationary universe, that wile remain unchanged.
3. Open universe, that will expand infinitely.

Aims

The objective of the article is to informar the population about historical science, in particular about the universe and the solar system.

Method of work: Througe searches on the web we are able to capture a variety of information about the universe and solar system.



Big Bang

Evoluzione dell'Universo e del Sistema Solare

Introduzione

Nel corso degli anni gli scienziati hanno formulato diverse teorie sulla formazione dell'universo ed eventuali evoluzioni. Non solo gli scienziati hanno formulato teorie sul sistema solare e l'universo ma anche i popoli primitivi hanno formulato dei miti per giustificare la nascita del sistema solare e dell'universo. La teoria più accreditata per la nascita dell'universo e la teoria del Big Bang, formulata da George Gamow. Esistono anche altre teorie, prive di giustificazioni e prove. L'età dell'universo e di circa 13,28 miliardi di anni e il sistema solare e di circa 4,5 miliardi di anni. Si pensa che l'evoluzione dell'universo sia una lenta espansione, la fine del sistema solare si pensa sarà dovuta al sole. Il sole esaurirà l'idrogeno che lo alimenta e si spegnerà. Ci sono anche diverse teorie filosofiche che riguardano l'universo e il sistema solare.

L'universo è un insieme di: materia, galassie, energia, pianeti, stelle e di sistemi tra cui il sistema solare. La teoria del Big Bang è confermata da osservazioni astronomiche, che ci permettono di affermare che il Big Bang è tutt'ora in corso, questo ci permette di formulare le teorie sulla forma dell'universo. Le teorie formulate fin ora sono 3:

- Teoria dell'universo chiuso, destinato a collassare.

- Teoria dell'universo stazionario, l'universo rimarrà invariato.

- Teoria dell'universo aperto, si espanderà all'infinito.

Obbiettivi

L'obbiettivo dell'articolo è quello d'informare la popolazione in ambito storico-scientifico, in particolare sull'universo e il sistema solare.

Metodo del lavoro: grazie alle ricerche sul web sono riuscito ad analizzare le teorie riguardanti il sistema solare e l'universo.

In various scientific sites I have found various information which concerned the subject of the article and I took the most important ones that allowed me to write the information throug which I have reworked the article.

Space component: In the universe there are a lot of materials. All the elements heavier then carbon, they have been produced by the nuclear fusin of some stars and then spread into space. Therefore all the elements of space and those present in the space result from the stars.

Structural levels of space: the first level is on aster, more asters united form structures. Between two asters very near each other, acts a strong gravitational force: they form a binary system. In the same wey the sun and the moon, in the solar system, form a binary system. Galaxies are huge collections of stars and they are independent systems. There are four kinds of galaxies:

•Elliptical,
•Spiral,
•Barred spiral.

Other components are planets, moons, minor planets, stars, the contents of intergalactic space, and all matter and energy.

Structural levels of solar system: in the solar system there are 8 planets divided into inner and outer planets, the planets are: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune. The sun is the star that occupies one focus. There are a lot of stars.

Results

Over the years people changed their mind about the universe and the solar system. Before the scientific revolution people thought that the earth was at the center of universe, referring to Aristotelian-Ptolemaic. Theory after the scientific revolution thanks to Nicolò Copernico and Galileo Galilei, people changed idea. They thought the sun was in the center of universe. Galilei thanks to telescope accepted the Copernican theory. But the religious institutions were against this theory, because they believed in the Aristotelian-Ptolemaic one and the church felt deprived of something that only it could explain. The religious institutions condemn ad and invited Galilei to retract his theory but, he refused. Now the theory is accepted, but the universe keeps changing.

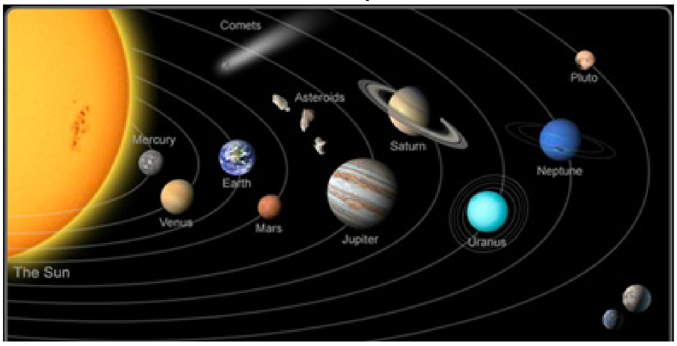
In vari siti scientifici ho trovato informazioni sull'argomento dell'articolo. Ho preso le informazioni più importanti e le ho rielaborate. Questo mi ha permesso di scrivere l'articolo.

Componenti dell'universo: nell'universo ci sono molti materiali. Tutti gli elementi più pesanti del carbonio sono stati prodotti dalla fusione nucleare di alcune stelle per poi diffondersi nello spazio. Quindi tutte gli elementi presenti nell'universo e sulla terra sono prodotti delle stelle.

Livelli strutturali dell'universo: il primo livello sono gli astri, più astri vicino formano strutture complesse. Tra due astri molto vicini agisce una forza gravitazionale e formano: un sistema binario. Ad esempio il sole e la luna, nel sistema solare formano un sistema binario. Le galassie sono enormi agglomerati di stelle indipendenti. Ci sono tre tipi di galassie:

•Ellittiche,
•Spirale,
•Spirale barrata.

Sistema solare: nel sistema solare ci sono 8 pianeti suddivisi in pianeti interni ed esterni, i pianeti sono: Mercurio, Venere, Terra, Marte, Giove, Saturno, Urano e Nettuno. Il sole è la stella del sistema ed occupa uno dei due fuochi.

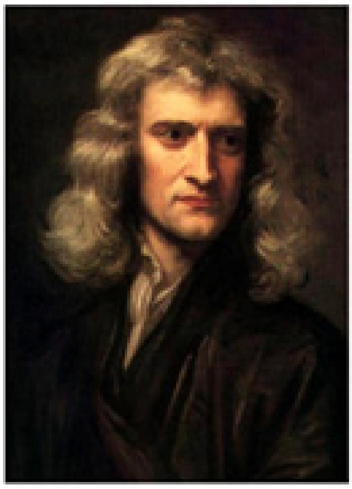


solar system
sistema solare

Risultati

Nel corso degli anni sono state cambiate diverse idea circa l'universo e il sistema solare. Prima della rivoluzione scientifica si pensava che la terra fosse al centra dell'universo, applicando così la teoria aristotelico-tolemaica. Dopo la rivoluzione scientifica grazie a Nicolò Copernico e Galileo Galilei e stata cambiata idea. Si penso infatti che il sole era al centro dell'universo. Galilei grazie al cannocchiale ha confermato la teoria Copernicana. Ma le istituzioni religiose non accolsero questa teoria, perché la loro concezione dell'universo si basava sul principio

The universe is in continuous changing. Another important scientist during the scientific revolution is Isaac Newton. He contributed to the progress of heliocentric theory. Newton formulated the law of universal gravitation.



Sir Isaac Newton

(1643 – 1727)

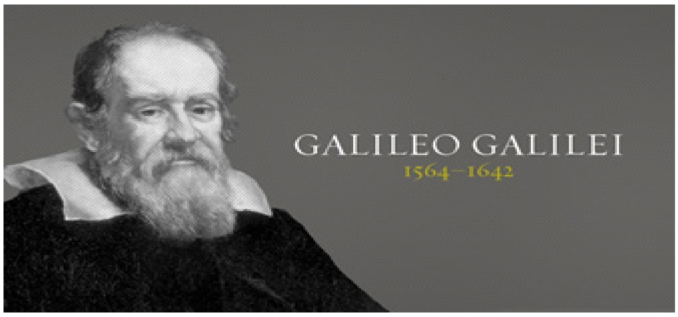
He affirmed that two bodies are attracted with a force directly proportional to their masses and inversely proportional to the square of their distances. This is a physical law derived by induction of the empirical method. Joannes von Kepler discovered the rules that describe the movement of planets. The rules are three:

1. The trajectory described by each planet is an ellipse and the sun occupies one focus.
2. The radius vector connecting the sun to the planet orbiting describes equal areas in equal times.
3. The ratio of the cube of the semi-major axis of the orbit and the square of the orbital period are the same for all planets.

There is a new idea on the universe: the existence of the multiverse that is, a universe outside our space-time defined parallel universe. This theory was created in 1896 by William James, then this theory was taken up by many producers to give life to science fiction films. In 1957, however, it was analyzed using the principles of quantum mechanics.

Conclusion

In conclusion the universe and the solar system are in constant evolution. They are



aristotelico-tolemaico e la chiesa si sente così privata di qualcosa che solo lei poteva spiegare. Le istituzioni condannano e invitano a ritrattare la teoria, ma Galilei si rifiuta. Ora la teoria è accettata ma, l'universo continua a cambiare.

L'universo è in continuo cambiamento. Un altro scienziato che contribuì al progresso durante la rivoluzione scientifica è Isaac Newton. Lui ha contribuito all'evoluzione della teoria eliocentrica. Newton formulò la legge di gravitazione universale. Affermava che due corpi si attraggono con una forza direttamente proporzionale alle loro masse e inversamente proporzionale al quadrato delle loro distanze. Questa è una legge fisica deriva per induzione e grazie al metodo empirico.

Giovanni Keplero scoprì invece le regole che descrivono il movimento dei pianeti del sistema solare. Le regole sono tre:

1. La traiettoria descritta da ogni pianeta è un'ellisse ed il sole occupa uno dei fuochi.
2. Il raggio vettore che collega il sole al pianeta orbitante descrivono aree uguali in tempi uguali.
3. Il rapporto tra il cubo del semiasse maggiore dell'orbita e il quadrato del periodo orbitale è uguale per tutti i pianeti.

C'è una nuova idea sull'universo l'esistenza del multiverso, cioè un universo al di fuori

Joannes Von Kepler

regulated by laws discovered in time by great scientists including Galilei Newton and Kepler, who have contributed to the evolution of science in general and not only to discover the laws that run the universe and the solar system.

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- Physis, https://www.google.it/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=0ahUKEwjS9ZeV-PbSAhWLuxQKHdkaCkoQjRwIBw&url=https%3A%2F%2Fphys.org%2Fnews%2F2016-09-scientists-universe.html&psig=AFQjCNGm6L_vJMjaAPJEgoiFzxFMG9yzRQ&ust=1490712784996149.

- https://www.google.it/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=&url=http%3A%2F%2Fwww.seasky.org%2Fsolar-system%2Fsolar-system.html&psig=AFQjCNHJgVKQ5AIXPWDGFkaYqiui2wAfjg&ust=1490712923094144.

- https://www.google.it/url?sa=i&rct=j&q-=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=0ahUKEwjKifXV-PbSAhWFvhQKHSbbC_IQjRwIBw&url=http%3A%2F%2Fwww.christianitytoday.com%2Fhistory%2Fpeople%2Fscholarsandscientists%2Fgalileo-galilei.html&psig=AFQjCNGHiyRkUI4rybrfHCzwW7BxUtGuUQ&ust=1490712958064540.

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del nostro spazio-tempo, può essere anche definito universo parallelo. Questa teoria è stata creata nel 1896 da William James, allora questa teoria è stata ripresa da molti registi per dar vita a film di fantascienza. Nel 1957, tuttavia, è stato analizzato utilizzando i principi della meccanica quantistica.

Conclusioni

In conclusione l'universo e il sistema solare sono in continua evoluzione. Essi sono regolati d leggi scoperte nel tempo da grandi scienziati, tra cui Galilei, Newton e Keplero, che hanno contribuito all'evoluzione della scienza in generale e non solo per scoprire le leggi che gestiscono l'universo e il sistema solare.

Bibliography

•Space,http://www.space.com/.
•Amnh, http://www.amnh.org/.
•Astrosociety, https://www.astrosociety.org/.
•Space, http://www.space.com/.
•Sapere, http://www.sapere.it/.
•Sapere, www.sapere.it/.
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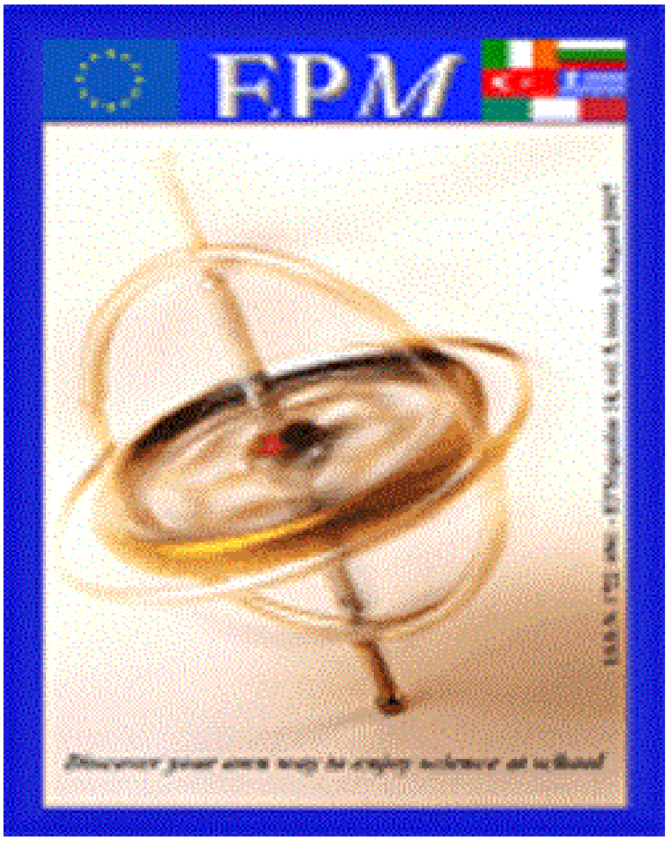

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