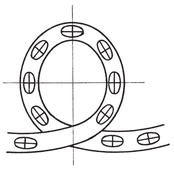
VÍSINDAMENN & SILFURBERG

VÍSINDAMENN SEM BREYTTU HEIMINUM - 19. TIL 20. ÖLD

SCIENTISTS & ICELAND SPAR

PEOPLE WHO CHANGED THE WORLD IN 19TH TO 20TH CENTURY



Ehrenberg var með hum fyrstu til að uppgötva, að lífrænir hlutar eins og hár, silki og hampur hafa tvöfalt ljósbrot í smásjánni skil. Þetta hefur reynst mjög gagnlegt við smásjárannsóknir í líffræði og textíliðnaði.

Ehrenberg was one of the first to discover that organic fibers such as hair, silk and hemp exhibit double refraction to some extent. This property has proven very useful in microscopical research in biology and in the textile industries.

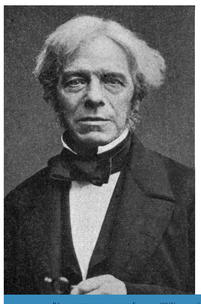
SCHMIDT, 1924

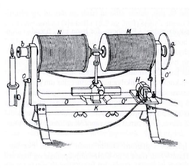
Gottfried Ehrenberg

1795-1876, Þýskalandi / Germany

Ehrenberg var einn frumkvöðla í notkun skautaðs ljóss við smásjárrannsóknir í líffræði, á 5. áratug 19. aldar.

Ehrenberg was a pioneer in the use of polarized light for microscopical studies in biology, in the 1840s.





Búnaður til að kanna hrif Faradays (1845), þ.e. snúning skautunarplans ljóss í efnum í segulsviði.

Equipment for studying the Faraday (1845) magneto-optic effect, i.e. rotation of the plane of polarization of light in materials placed in a magnetic field.

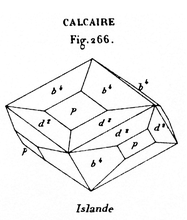
ROTT, 1846

Michael Faraday

1791-1867, Englandi / England

Faraday rannsakaði mikilvæga þætti varðandi seguleiginleika silfurbergs og árið 1845 fann hann einnig að segulsvið hafði áhrif á skautað ljós í efnum með hjálp þess.

Faraday investigated important aspects of the magnetic properties of Iceland spar, and also found in 1845 with the aid of Iceland spar prisms that magnetic fields affected the passage of light through materials.



Teikning Des Cloizeaux af Íslenskum silfurberjakristalli af óvenjulegri lögun. Úr bók hans um steindafræði.

A drawing by Des Cloizeaux of an Iceland spar crystal of unusual shape, from his monograph on mineralogy.

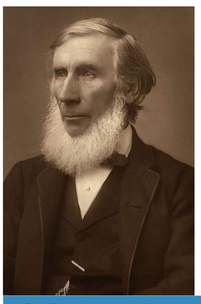
DES CLOIZEAUX, 1874

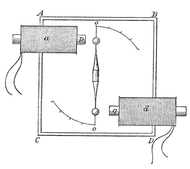
Alfred Des Cloizeaux

1817-1897, Frakklandi / France

DesCloizeaux var einn merkasti steindafræðingur síns tíma. Rannsóknir hans studdust mjög við athuganir á kristöllum í smásjá með skautuðu ljósi. Hann kom tvisvar til Íslands.

DesCloizeaux was one of the most productive mineralogists of his time, frequently employing polarized light in his microscopical studies on crystals. He visited Iceland in 1845 and 1846.





Tilraun Tyndalls á upphengjum kúlum úr silfurberjakristöllum 1850. Hann staðfesti þar niðurstöður M. Faradays um að seguleiginleikar kristalla verði hlaðir stefnu miðað við samhverfuása þeirra.

Tyndall's 1850 experiment on a pair of suspended Iceland spar spheres. It confirmed M. Faraday's conclusion that the magnetic properties of crystalline materials depend on direction relative to symmetry axes.

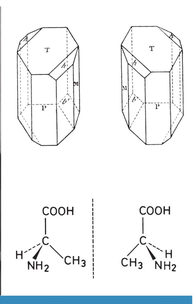
LIEBISCH, 1891

John Tyndall

1820-1893, Írlandi-Englandi / Ireland-England

Tyndall hélt rannsóknum M. Faradays áfram á seguleiginleikum silfurbergs, og varð eftirmaður hans við Royal Institution. Hann leysti á árinu 1869 gátuna um orsök himinblámans, með hjálp silfurbergsprisma.

Tyndall continued M. Faraday's observations on the magnetic properties of Iceland spar, and became his successor at the Royal Institution. In 1869 he used Iceland spar prisms in experiments which demonstrated why the sky is blue.



Pasteur (1848) vísindi fram á, að vatnslausnir speglu-samhverfra kristalla af vísindræðilegum uppruna skautunarplani ljóss sín í hvora áttina. Vísindamennirnir van't Hoff og le Bel stungu síðan upp á því 1874, að þrívíð innatengni kolefnis gæti myndað speglasamhverfar sameindir. Hugsi: Ísefnilegt er það amínósýran alanín.

Pasteur (1848) demonstrated that aqueous solutions of mirror-image tartrate rotated the polarization of light respectively to the left and to the right. Subsequently, Hoff and Bel suggested in 1874 that three-dimensional chemical bonds of carbon could form mirror-image molecules. In this case it is the amino acid alanine.

Smásjármynd af hunninnsi af blágrýti, sem sýnir kristalla mismunandi steintegunda.

Color drawing of a transparent thin section from a volcanic rock, viewed in a microscope.

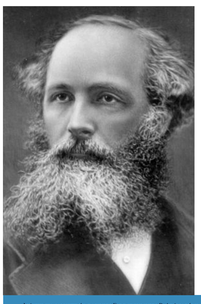
ZIRKEL, 1876.

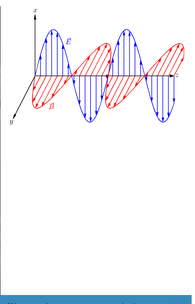
Ferdinand Zirkel

1838-1912, Þýskalandi / Germany

Zirkel varð ásamt H.C. Sorby helsti frumkvöðull í bergfræðirannsóknum með þeirri aðferð að skoða þunnsneiðar bergs í smásjá með skautuðu ljósi. Hann ferðaðist um Ísland 1860 og doktorsrit hans fjallaði um bergsýni frá Íslandi.

Along with H.C. Sorby, Zirkel pioneered the use of polarized light for microscopical studies in petrography, using thin sections of rocks. In 1860 he travelled in Iceland, collecting samples of volcanics for his doctoral thesis.





Ljósgeislí sammetý úr rafsviði E og segulsviði B, í tómarúmi. Hún ferðast í stefnuna z sem er hornrétt á báðir sviðin.

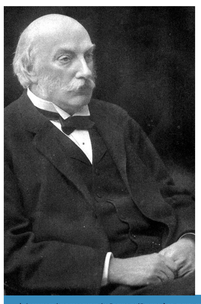
Maxwells theory about the characteristics of light: Electric (E) and magnetic (B) fields in a electromagnetic wave in free space. The wave is travelling in the direction of the z axis.

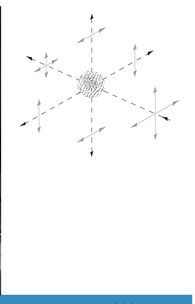
James Clerk Maxwell

1831-1879, Skotlandi-Englandi / Scotland-England

Maxwell setti fram kenningu á árunum 1862-65 um að ljósbylgjur samanstandi af sveiflum raf- og segulsviða. Hann byggði þar talsvert á eigin reynslu af athugunum á skautuðu ljósi og á silfurbergi, auk uppgötvana Faradays. Kenningin fékk smám saman staðfestingu með tilraunum á næsta aldarfjórðungi, og kom silfurberg þar enn við sögu. Hún varð grundvöllur að nútíma eðlisfræði og mörgum meiriháttar tæknieftirframförum 20. aldar.

Maxwell proposed in 1862-65 that light waves consist of electrical and magnetic oscillations. This idea was in part based on experiments with polarized light and Iceland spar by himself and M. Faraday. It gained support gradually during the next quarter-century, to some extent due to observational evidence involving Iceland spar. The electromagnetic theory forms the basis for modern physics and for a wide range of major technical achievements in the 20th century.





Ljósgeisli frá hlaðri lendu á mörgum smágögnum. Þar gleypa hluta af ljósinu og senda það aftur frá sér út til hliðanna. Rayleigh útskýrði þróunina 1871, hve mikið af ljósinu dreifist á hennar háð og hvers vegna sveiflurkeyfingin í því er í tilteknar áttir eins og sýnt er.

An unpolarized ray from the left encounters a collection of small particles. They absorb some of the light and re-radiate it sideways. Rayleigh derived in 1871 theoretical equations for the intensity and the polarization (arrows) of this scattered light.

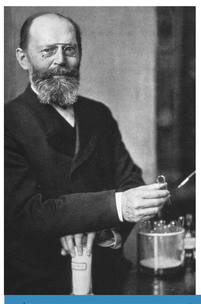
FOWLES, 1975

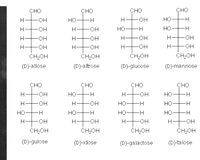
John William Strutt, 3rd Baron Rayleigh

1842-1919, Englandi / England

Rayleigh gerði margskonar ljósfræðirannsóknir með silfurbergsprismum, meðal annars varðandi hreyfingu jarðar í ljósvakanum. Hann setti fram fræðilegar jöfnur um dreifingu skautaðs ljóss frá smáögnum, sem staðfestu tilraunaniðurstöður J. Tyndalls um orsök himinblámans.

Rayleigh carried out many research projects in optics with the aid of Iceland spar prisms, including attempts to measure the Earth's speed relative to the aether. His theoretical equations for the scattering of light confirmed J. Tyndall's experimental results on the cause of the blue sky.





Átta mismunandi sykurefni með sex kolefnisfrumeindum (aldóhexósar). E. Fischer hlaut Nóbelverðlaun sín 1902 m.a. fyrir grundvallarannsóknir á þeim.

Molecular structure of eight different sugars with six carbon atoms (aldo-hexoses). In 1902 E. Fischer was awarded the Nobel prize in Chemistry for his fundamental research on the structure of carbohydrate molecules.

PRINGSHEIM, 1925

Hermann Emil Fischer

1852-1919, Þýskalandi / Germany

Fischer notaði skautað ljós við rannsóknir á sameindabyggingu margra líffræðilega mikilvægra efnaflokka, svo sem sykurefna og amínósýra. Hann fann upp nýjar aðferðir til þess og bjó til fjölmörg efni í þeim flokkum, sem ýmist voru áður þekkt úr náttúrunni eða ófundin.

Fischer applied polarized light in his investigations on molecular structures in several classes of biologically important organic chemicals, including sugars and amino acids. He synthesized many such chemicals, some already known from natural sources and some not.

Heimildir / References:

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Leó Kristjánsson

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Fjarðabyggð
Menningarráð Austurlands
Sóknarætlun Austurlands
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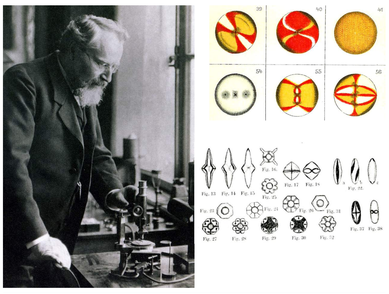
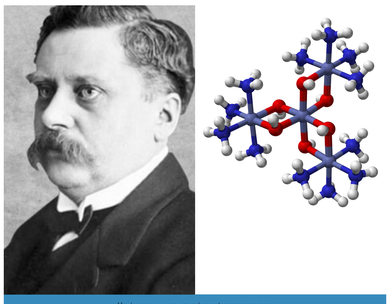


Sérkennileg mynstur sem sáust í fljótandi kristöllum í smásjá með skautuðu ljósi, þegar ábreiðum sá, hitastig var breytt.
Strange patterns exhibited by liquid crystal specimens, when viewed in a polarizing microscope under varying conditions, atom not stated.
LEHMANN, 1900 & 1911-13

Otto Lehmann
1855-1922, Þýskalandi / Germany

Lehmann uppgötvaði hina sérstöku ljóseiginleika svokallaðra fljótandi kristalla árið 1889 og rannsakaði þá mjög ítarlega í 30 ár. Skautað ljós var ómissandi við þær rannsóknir, sem meðal annars hafa leitt til þróunar flatskjáa.

Lehmann discovered the peculiar optical properties of so-called liquid crystals in 1889 and carried out comprehensive investigations on them for 30 years. Polarized light was quite essential in this research, which has for instance resulted in the development of flat TV screens and displays.

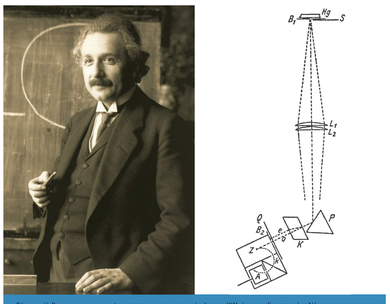


Hexól, efnasamband með fjórum kóbalt-frumeindum.
Áhrif lausna af hexól-söltum á skautað ljós veitti mikilvægan stuðning við kenningar Werners um efnatengi keðjunum 1910.
Hexol, a cobalt-ammonia complex. The effect on dissolved hexol salts of polarized light provided strong support for Werner's novel theories of chemical bonds around 1910.
WIKIPEDIA

Alfred Werner
1866-1919, Sviss / Switzerland

Nýstárlegar kenningar Werners um efnatengi milli frumeinda fengu verulegan stuðning af áhrifum tiltekinna efna á skautað ljós. Þær breyttu mjög hugmyndum um byggingu sameinda, og eyddu einnig meginmun sem var talinn vera milli lífrænna og ólífrænna efna.

Strong supporting evidence for Werner's novel concepts of chemical bonds was provided by the effect of certain compounds on polarized light. This revolutionized chemists' ideas of molecular structure, and erased the walls existing between organic and inorganic chemistry.



Bónaður C. Ramsauers við rannsókn tilteknna eiginleika ljósröðunar 1921, árið sem Einstein fékk Nóbelsverðlaun fyrir fræðilega skýringu: sýna á því fyrirbrigði. Ljós frá lampanum Hg fellur gegnum silfurbergsprismað K á leyla eindaðýti Z og losar ör sínni rafeindir.
C. Ramsauer's experimental setup to clarify Lenard's or the photoelectric effect in 1921, the year when Einstein received the Nobel prize in physics for his theory of that phenomenon. Light from the lamp Hg is polarized by the Iceland spar xhosm K before falling on a zinc-vessel Z, releasing electrons.
RAMSAUER, 1921

Albert Einstein
1879-1955, Þýskalandi-Sviss-USA
Germany-Switzerland-USA

Einstein setti fram nýjar fræðikenningar um ýmis fyrirbrigði í eðlisfræði, þar sem fyrri kenningar duguðu ekki til útskýringa á niðurstöðum tilrauna. Silfurberg var notað við sumar þær tilraunir, sem og við prófun á kenningum Einsteins og beitingu þeirra á ný fyrirbrigði.

Einstein proposed alternative theoretical foundations for various physical phenomena where previous theories had not accounted satisfactorily for observational results. Some of these observations had involved Iceland spar; it was also used in many experiments aimed at verifying Einstein's predictions and at applying them to new situations in physics.

NÓBELSVERÐLAUN OG SILFURBERG

NOBEL PRIZES AND ICELAND SPAR

1. Uppgötvanir sem hefðu varla verið gerðar án silfurbergs eða Nicol-prisma
Discoveries which depended much on the use of Nicol prisms

EMIL FISCHER, Efnafræði - Chemistry **1902:** Skilningur á byggingu sameinda af sykri og fleiri efnum sem hann smíðadi - Synthesis of sugars and other organic compounds
ALFRED WERNER, Efnafræði - Chemistry **1913:** Nýjar víddir opnudust í ólífrænni efnafræði með rannsóknum hans - Coordination bonds, a new concept in chemistry

2. Uppgötvanir þar sem skautun ljóss, silfurberg eða Nicol-prismu skiptu talsverðu máli en voru e.t.v. ekki afgerandi
Discoveries where polarization of light played a considerable part

H.A. LORENTZ & P. ZEEMAN, Edlisfræði - Physics **1902:** Zeeman-hrif - Zeeman magneto-optic effect
J. STARK, Edlisfræði - Physics **1919:** Stark-áhrif rafsvids á litrófslínur - Stark electro-optic effect on spectral lines
H. V. EULER, Efnafræði - Chemistry **1929:** Gerjun og edli ensíma - Fermentation and the nature of enzymes
C.V. RAMAN, Edlisfræði - Physics **1930:** Raman-ljósdreifing - Scattering of light, with change of wavelength

3. Uppgötvanir þar sem kalkspat (íslenskt silfurberg) eða Nicol-prismu komu eitthvað við sögu
Discoveries where Nicol prisms or calcite crystals played some part

W. OSTWALD, Chemistry **1909**, used polarimeters in some of his studies on chemical processes cited by the Nobel committee.
O. WALLACH, Chemistry **1910**, was awarded the prize for his work on terpene and camphor compounds from plants, which included optical activity measurements.
R. WILLSTÄTTER, Chemistry **1915**, notes in his work on flower pigments that some of these exhibit high optical activity and rotatory dispersion.
He also used polarimeters and other instruments with Nicol prisms in his research on cellulose, alkaloids, hydrolysis, and enzymes.
THE X-RAY DIFFRACTION STUDIES OF W.H. & W.L. BRAGG, Physics. **1915**, **M. Siegbahn**, Phys. **1924**, and **A.H. Compton**, Phys. **1927** all employed calcite crystals for accurate wavelength measurements.
THE RESEARCH OF R.A. ZSIGMONDY, Chemistry **1925**, on colloids which included observations of light scattering and polarization, was preceded by his studies on colored glasses.
Zsigmondy's achievements in turn inspired investigations by **J.B. Perrin**, Phys. **1926**, on the atomic structure of matter.
A. WINDAUS AND H. WIELAND, Chemistry **1928**, both measured optical activity in sterol compounds.
H. FISCHER, Chemistry **1930**, employed polarimeters in some of his work on haemin and chlorophyll (including special equipment to measure strongly colored solutions).
W.N. HAWORTH, Chemistry **1937** elucidated the structural constitution of many saccharides and other carbohydrates. His group was also the first to synthesize the optically active compound ascorbic acid (Vitamin C).
R. KUHN, Chemistry **1938** did some of his prize-winning work on carotenes with a polarimeter, as well as research on mutarotation, fermentation and amygdalin derivatives in the early **1920s**. He also wrote major review papers on optical activity.

4. Nóbelsverðlaunahafar sem gerðu ýmsar rannsóknir með silfurbergi eða á skautuðu ljósi, en fengu verðlaunin fyrir annað
Nobel laureates who published papers on work involving polarized light or calcite, but received their prizes for discoveries in different fields

J.H. VAN'T HOFF, Chemistry **1901** (and independently **J.A. le Bel**) put organic chemistry on a new foundation by their publications (e.g. **Hoff 1874**) arguing that optical activity of some carbon-containing molecules is due to mirror-image symmetry in three-dimensional bonds of carbon.
W.C. RÖNTGEN, Physics **1901** investigated the Kerr and Pockels electro-optic effects, as well as the Faraday magneto-optic effect in gases.
S. ARRHENIUS, Chemistry **1903** used polarimetric observations made by himself and others for his theoretical analysis of chemical reaction kinetics.
H. BECQUEREL, Physics **1903** did valuable research on the Faraday and Zeeman magneto-optic effects.
RAYLEIGH, Physics **1904** wrote a number of papers on theoretical and experimental aspects of polarized light, especially the scattering of light by small particles as observed by **J. Tyndall**.
J.J. THOMSON, Physics **1906** wrote theoretical papers on polarized radiation.
A.A. MICHELSON, Physics **1907** included some observations of polarization in his research on the Zeeman effect.
F. BRAUN, Physics **1909**, published papers on double refraction in inhomogeneous materials.
W. OSTWALD, Chemistry **1909** as mentioned above, used the interference of polarized light in his later influential studies on color perception.
A. GULLSTRAND, Physiol./Medicine **1911**, described some ophthalmological procedures where Nicol prisms played a part.
J. STARK, Physics **1919** as mentioned above, also studied for instance canal rays and photographic materials with polarizing photometers.
W. NERNST, Chemistry **1920**, published a well-known paper with **P. Drude** on the polarization of standing light waves, and also papers where a Wanner pyrometer with Nicol prisms was employed in high-temperature research.
A. EINSTEIN received his Physics **1921** prize for theoretical work on the photoelectric effect as a quantum-mechanical phenomenon. Many results on polarized light by various experimentalists led up to his discoveries on this matter and others, while subsequent experiments confirmed and sometimes extended Einstein's conclusions. See a separate account about him on www.raunvis.hi.is/~leo.
N. BOHR, Physics **1922**, **J. Franck** and **G. Hertz**, Phys. **1925**, **W. Heisenberg**, Phys. **1932**, and **E. Fermi**, Phys. **1938** wrote on polarized fluorescence, resonance radiation and related topics.
F.W. ASTON, Chemistry **1922**, began his career by investigating optically active organic compounds with **P.F. Frankland**.
O. MEYERHOF, Physiol./Medicine **1922**, wrote papers on fermentation.
R.A. MILLIKAN, Physics **1923**, measured the polarization of heat radiation in **1895**.
A. HARDEN, Chemistry **1929** studied the rotatory power of glycogen in the early **1900s**, and later investigated polysaccharides, enzymes and the resolving effect of microorganisms on optically inactive acids.
K. LANDSTEINER, Physiol./Medicine **1930**, was making polarimetric observations on blood serum in the late **1920s**.
O. WARBURG, Physiol./Medicine **1931**, began his scientific career in research on optically active organic compounds with **E. Fischer** (category **1** above).
P. KARRER, Chemistry **1937**, did his doctoral research on cobalt complexes under **A. Werner** (see category **1** above) and later carried out various studies (on polysaccharides, vitamins, tannins, glucosides, alkaloids etc.) where polarimeters were employed.
E.O. LAWRENCE, Physics **1939**, used electro-optic Kerr cells in research in the **1920's**.
G. DE HEVESY, Chemistry **1943** depended on calcite crystals in his pioneering studies on chemical analysis by **X-ray** fluorescence in the **1920s**.
M. BORN, Physics **1954** wrote important theoretical papers and books on crystal optics, the Kerr effect, and optical activity (e.g. **Born 1935**).

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