AN ELEMENTAL TYPOLOGY

Taking the scientific grid as a point of departure this typology traces the prolix potential of collapsing scientific, industrial, philosophical, spiritual and informal knowledge practices alongside images

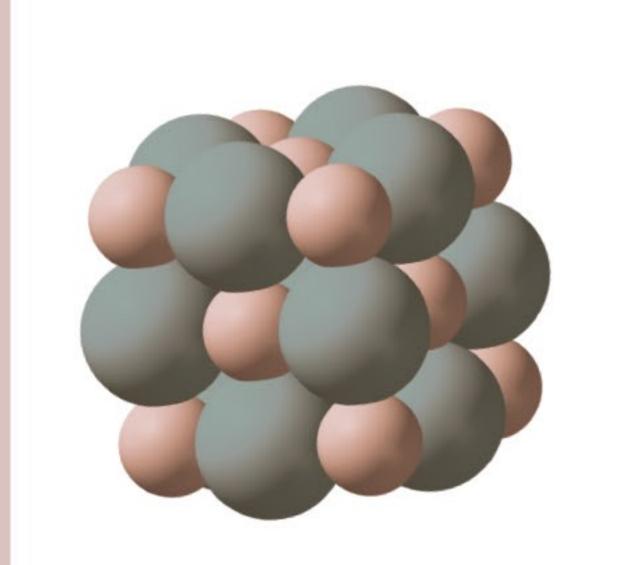
from the public domain into new mineralogical arrangements. This fictive inventory draws on real data to generate an archaeological dig across geographies and histories and in the process, renders visible new architectures of time and matter. Collecting and reassembling these phenomena, scientific truth is brought

together with the irrational, the fabricated and the blithely intuited wherein mineral infrastructures permeate both the physical and conceptual layers of the project. Working with four distinct and non-hierarchical categories, this data mining is stratified for the purposes of condensation and displacement, elucidation and

transformation. Ultimately, these borrowed images and the specific stories they uncover are adapted towards new formations, allowing for an emergent legibility of a world beyond words where matter comes to matter.

SONGS OF SCIENCE

the vibrational energy and ordered particles of minerals, the earth's primordial elements, are harnessed to reveal the Songs of Science. ithin their rational methods these practices contain poetic and



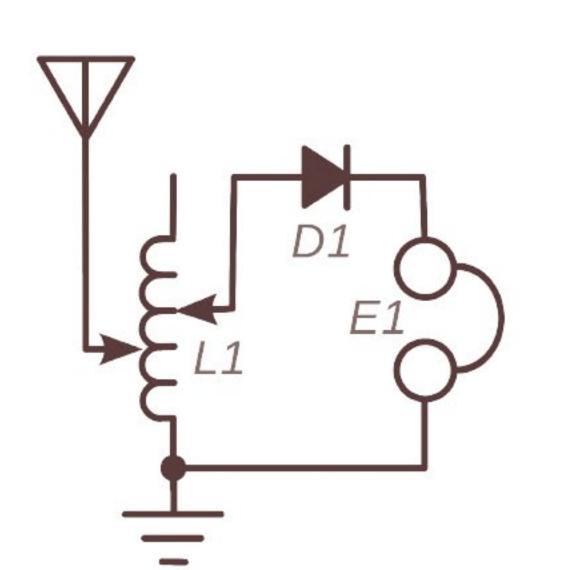
MINERAL MEDICINE

Minerals, essential nutrients in the human body, include calcium, potassium, sodium, magnesium, phosphorus and chloride as well as trace minerals such as iron, iodine, manganese, chromium, fluoride, copper, selenium and zinc. Minerals have been used as medicine and cosmetics in Ancient Egypt, Greece and Rome while Assyrian and Babylonian texts contain descriptions of their magicmedical powers. For example, Egyptian malachite, which contains copper was used for diseases of the abdomen and dental problems perhaps due its antimicrobial effects (see Sacred Copper). In Indian Ayurvedic medicine, various gems are believed to increase longevity (diamonds), cure fever (aquamarine) or heal skin diseases (topaz). In Chinese medicine, geological minerals including mud, clay and pulverized fossil remains help to restore an imbalance of energy. And like many of its neighbours, Islamic medical texts suggest that fossils and gemstones were used in tonics most of these practices have been found to have both curative and magical properties.



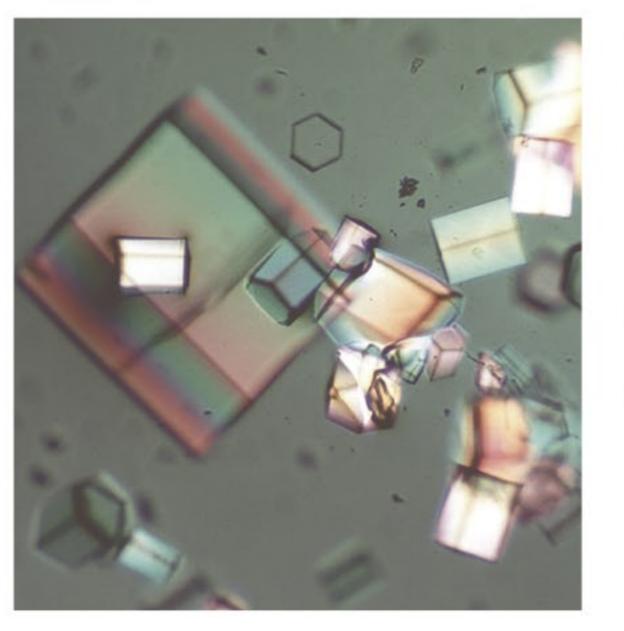
PIEZOELECTRIC EFFECT

Jewel bearings were first used in watches in 1702 to reduce friction. A century and a half later in 1880 the pressure) was discovered when tourmaline, quartz and topaz were subjected to mechanical stress. The word piezoelectricity comes from the Greek piezein, meaning, "to squeeze". In 1927, quartz was introduced to timekeeping to regulate an electronic oscillator, making it even more accurate than mechanical clocks. When compressed or an electrical charge is applied, specific crystals can generate an electrical current called the piezoelectric effect. The frequency of this vibration, thousands of times per second, is in part a function of the cut and shape of the stone. Mechanisms that rely on piezoelectricity include inkjet printers, quartz watches, sonar technology, smoke detectors, autofocus cameras, pick ups in electric guitars, and monitors in medical ultrasound to name but a few. Contact microphones use piezoelectricity to turn sound energy into electrical signals. And stylus or record player needles are made from a variety of materials including sapphires and diamonds also in order to generate a piezoelectric effect.



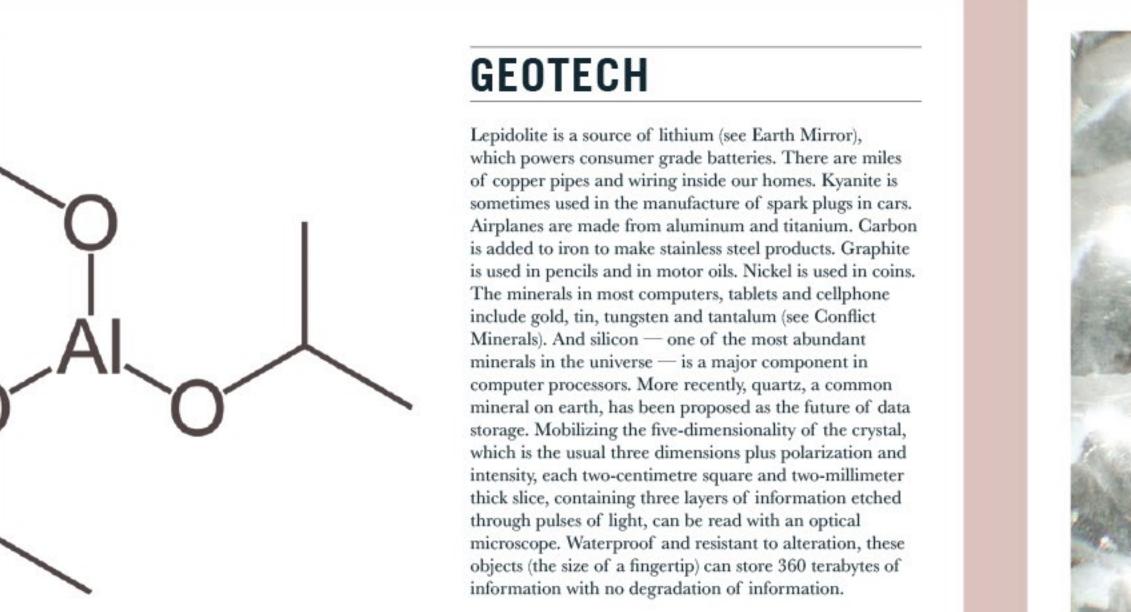
CRYSTAL RADIO

Mineral specimens as lively objects inform the relationship of crystals and radio signals. In one form, a crystal radio receiver, sometimes referred to as cat's whisker receiver, operates through radio waves via a wire antenna. The rystal component made from the mineral galena or pyrite offers up its capacity for natural frequencies and vibrations although the signal is quite weak. The other type of crystal radio requires an outside power source to harness the energy within the mineral. Building on this technology the mineral germanium, which is chemically similar to silicon, can act as a semi-conductor in transistors and other electronic devices. Currently, these crystal diodes are used in radar as well as the semi-conductors found n computers. And modern crystal radio sets can contain both a crystal oscillator and piezoelectric crystal earpieces



CRYSTALLOGRAPHY

Crystallography determines the atomic and molecular structure of a crystal. The method is important in understanding atoms, their chemical bonds as well as the three-dimensional structures of biomolecules. The arrangement of atoms determines the characteristics of a given material as well as chemical interactions and processes. Crystallographers study a diverse array of substances from living cells and superconductors to diamonds, viruses, gases and DNA. Indeed, Rosalind Franklin used crystallography in her discovery of the double helix structure of DNA. Working in such disciplines as chemistry, geology, biology, materials science metallurgy and physics, crystallographers use conventional (x-rays) and emergent technologies including atomic force microscopy, neutron diffraction, electron crystallography, molecular modeling, high- and low-temperature studies, high-pressure diffraction and micro-gravity experiments in



and other forms of future technology (see GeoTech).

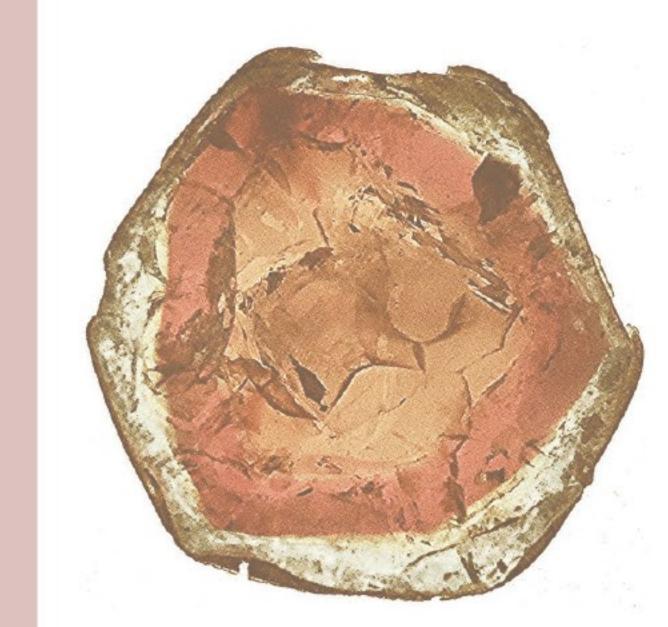


TIME CRYSTAL

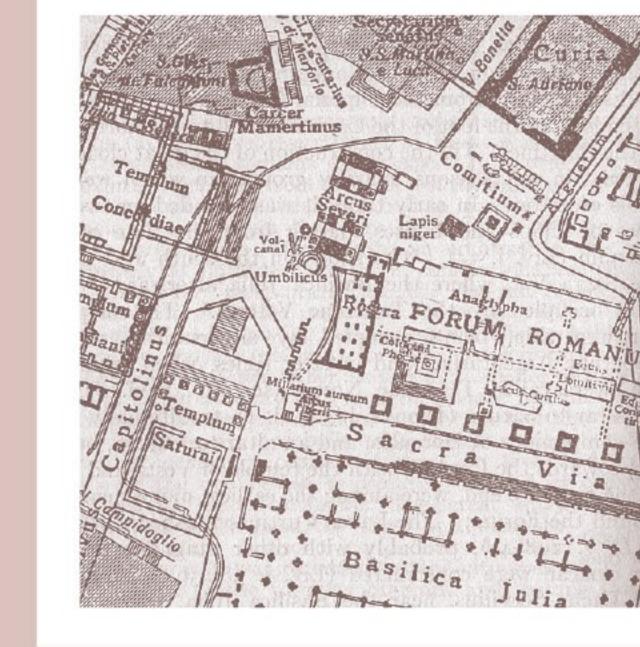
The stuff of science fiction, crystals behave differently than other forms of matter. Time Crystals, according t a recently proven theory that breaks the second law of thermodynamics, have an atomic structure that repeats no be asymmetrical in space, Time Crystals are asymmetric in time, extending the ordinary three-dimensional crysta symmetry to include the fourth dimension of time. A fracture in time's symmetry allows these substances to stay in perpetual motion. As Time Crystals oscillate in their ground state, matter and structure are created by a time loop that repeats itself. What this means is that they move without energy. This new form of quantum matter is radically changing our understanding of the space-time continuum and the theory of time in general allowing

SUPERNATURAL ORACLES

organic matter and the material vitality that lies within



Tourmaline gets its name from the Sinhalese (Sri Lankan) word tura mali meaning stone of mixed colors. Legend tells us that tourmaline comes in many hues from indicolite blues and blue-green), verdelite (greens), rubellite (reds and pinks), cat's eye (striped brown), paraiba (bright neon blue), schorl (black), dravite (yellows and browns) and watermelon (green and pink). The Ancient Egyptians believed that tourmaline travelled up or down (!) a rainbow capturing its unique spectrum along the way. The pink version of this stone was highly desired by the last Empress of China, Empress Dowager Tzu. For centuries, the Chinese have carved this stone into intricately crafted snuffboxes and figurines. Tourmaline has piezoelectric qualities. When heated, bent or stressed it develops a static charge that attracts lightweight particles to its surface. As a result they gain a positive charge at one end and a negative charge at the other (see Piezoelectric Effect). This might explain why African and Australian shamans valued it for medicinal purposes (see Medicinal Medicine) as well as by alchemists who believed that it related to the philosopher's stone (see The Philosopher's Stone) by reconciling opposites and changing base metals to gold.

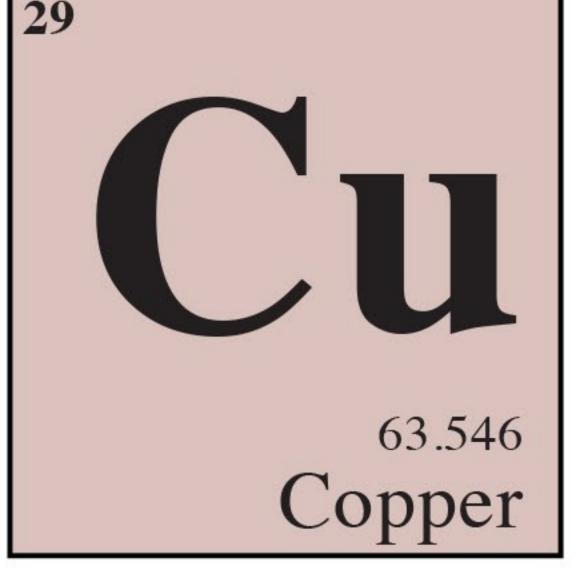


Veneration of stones by humans is part of the earliest forms of spiritualty and kinship practices. Whether in response to their beauty, their shape, their material or their unusual markings, these natural forms have inspired worship and respect for millennia. Take for example the Lapis Nigir, a shrine in the Ancient Roman Forum covered in black marble the purpose of which is unclear. A more famous version is the Kaaba, an Islamic pilgrimage site located in Mecca whose cube structure is made of granite, marble and limestone. Inside the building in the eastern corner is the Black Stone, a Muslim relic believed to have fallen from the heavens as a guide for Adam and Eve to build an altar. Alternately described as a meteorite, basalt, agate and even glass, its actual composition is unknown. Another example is the Sacred Stone Camp in North Dakota on the Standing Rock Indian Reservation, which refers to the sacred stones for which the area was riginally named. Here large, spherical stones were created by the confluence of currents where two rivers meet. More respect than veneration, this last example suggests a relational understanding of and respect for matter,



THE NORTHERN LIGHTS

Labradorite — also know as black moonstone — is a form of plagioclase feldspar found in the Canadian province of Newfoundland and Labrador as well as other parts of Canada, the United States, Mexico, South America, Finland and Norway. In Inuit lore, the stone is believed to have fallen from the frozen fire of the Aurora Borealis. In another version of the story, the Northern lights were trapped in the stone when a warrior pierced it with his spear and most of its spectrum was released into the sky. The colours that remained are what we know as labradorite, an optical phenomenon where light rays coming out of the stone are different than those that went in. This refraction of light as iridescent flashes of peacock blue, gold, pale green, or coppery red is known as labradorescence. Labradorite was used by the Boethuk peoples of Newfoundland and Labrador and is now incorporated into jewellery, glassmaking, ceramics and road building. It is composed of calcium, sodium, aluminum and silicate. Occurring in igneous rocks, labradorite is the feldspar variety most common in basalt.



SACRED COPPER

Copper has been a sacred metal for many civilizations. Initially its salts were used as a pigment for blue and green colours. For thousands of years copper has been smelted from ore, cast into molds and alloyed with tin to create bronze. It name comes from the Latin es cyprium or metal of Cyprus where it was discovered early in the island's history. Ancient Egyptians, Filipinos, Greeks and Romans integrated it into jewellery while medieval Europeans caste coins with its malleable metal. Indigenous peoples throughout the Americas revered copper as a sacred material using it fo tools as well as ceremonial purposes and the distribution of wealth. The peoples of the Lake Superior/Upper Great Lakes region told stories about Mishipeshu, a fierce guardian whose charge was to protect the sacred copper. In the Pacific Northwest is the story of Copper Woman, the first woman made by the Creator. In the modern era, copper has become fundamental to electrical and households goods as a conductor of heat and electricity. Perhaps less know are its antimicrobial properties and use in wood preservatives, doorknobs, faucets and other places likely to collect bacteria. And of course, copper is essential to all living organisms as trace dietary mineral (see Mineral Medicine).



variety of chalcedony, a form of silica composed of quart and moganite. Its colour comes from the nickel oxide present in its composition. The word ending prase is a color-descriptor signalling its greenish hue, which comes from the Greek for leek. Indeed, it is the color rather than any pattern of markings that has made chrysoprase so desirable. Deposits of this form of quartz have been found in Russia, Eastern Europe, Brazil, Madagascar, Tanzania, South Africa, Australia and the USA. The Romans first identified it in 23 C.E. when the stone was believed to strengthen relationships and empower deep understanding. It was considered a magical stone that was re-charged at the half-moon by exposing it to the night sky. Some cultures believe that the properties of Chrysoprase allow the bearer to become invisible when a fragment is placed in the mouth. In Romanian folklore, it gives the power to access the language of lizards, who are believed to represent the soul's search for awareness and expansion The Roman poet Ovid who was exiled to Romania in 8 C.E. wrote about transformation myths from human to inanimate objects and from animals to humans.



North and South American Indigenous peoples, Persians, Indians, Egyptians, Chinese, Celtic Druids and traveling Roma, first practiced gazing into a seer stone or crystal ball. In one Egyptian legend, the goddess Hathor carried a shield that could reflect back all things in their true light. The Shahnama, a Persian text from the late 10th century describes the pre-Islamic Cup of Jamshid used by wizards and practitioners for observing all the seven layer of the universe. Beryl was the preferred mineral for this kind of fortune-telling, a form of mediumship through communication with other realms. The practice is also known as scrying, which comes from the Old English word descry meaning "to make out dimly". The stone was often polished into a sphere to bring out its reflective propertie More generally, a transparent sphere of any material with refractive qualities can bring a focus near the surface. Staring deep into the ball's translucence is believed to induce a meditative trance, opening the unconscious to reveal secrets from multiple temporal directions.

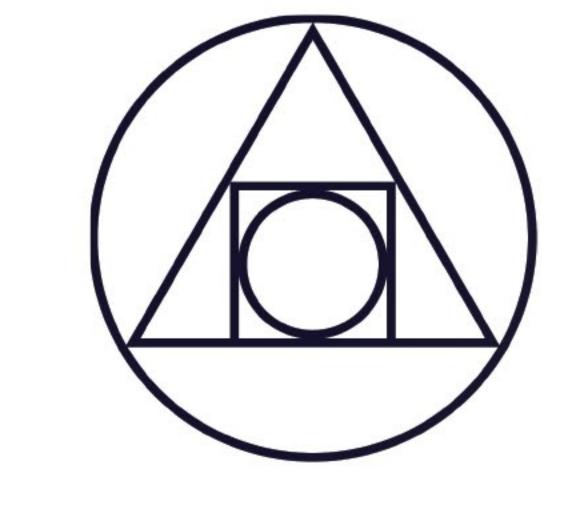
NATURAL PHILOSOPHY

hysical universe especially those beings and entities that undergo hange. Here the term posits practices that bridge the study of na and the nature of study where the speculative unity of nature ar



ROCK VS. STONE

Rock, a composition of elements, signifies a conglomerate of minerals as well as cultural and metaphysical objects. 'he term rock is itself a Gordian knot of geoscience, linguistics and anthropology. Take for example the distinction of rock vs. stone. A rock is a naturally occurring aggregate of minerals formed by geological processes. By contrast, a stone is a formation altered by humans whether as a tool, an architectural feature or an aesthetic form. A rock is not a stone. To further complicate things, rocks and stones can be confused with minerals, gems and crystals. The word mineral comes from the Latin minerale or "obtained by mining" and refers to a naturally occurring solid substance with a specific chemical composition. Minerals are made of one or more elements that are arranged in a three dimensional pattern also know as a crystal structure. The habit or shape of a crystal is the outer manifestation of the repeating internal structure of its atoms. A rock is a material made up of two or more minerals classified as igneous, metamorphic or sedimentary. While a rock or a stone is not necessarily a crystal, all three are composed of minerals.

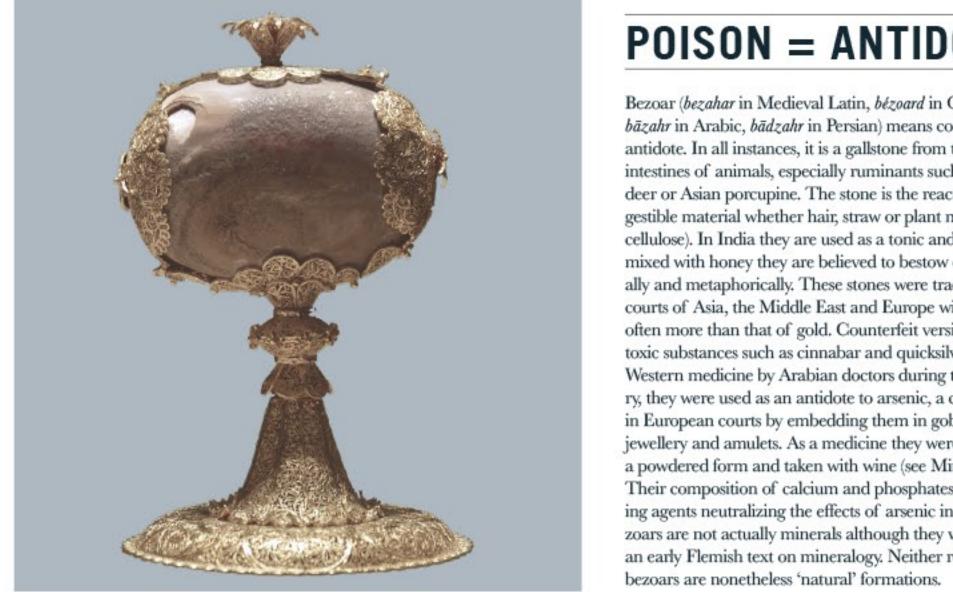


PHILOSOPHER'S STONE

First described in Alexandrian, Chinese and Arabian texts and a central component of early scientific practices, the philosopher's stone — sometimes called materia prima was an alchemical substance ground into a powder that could transform basic metals into gold. For the purposes of making gold the stone was a transparent ruby or saffron colour soluble in any liquid, yet incombustible in fire. The liquid elixir (al iksir in Arabic) derived from the powder was believed to cure illness and extend life in the form of a tincture (see Mineral Medicine). The philosopher's stone, the most tangible and dense crystallization of a subtle substance, was also a metaphor for an inner transformation. Here the transmutation of metals, and the purification and rejuvenation of the body were seen to be manifestations of the same concept. The stone's vibrational energy was believed to reconfigure physical matter. It is called a stone, not because it is like a stone but for its concentration of subtle substances, a living mineral into a solid form.



Twelve percent of minerals found in the earth's crust are quartz, a mineral composed of silicon dioxide and oxygen atoms. It is the second most abundant mineral in Earth's continental crust, behind feldspar. More than the popular transparent form, there are many types of quartz including agate, amethyst, citrine, jasper, tiger's eye, and onyx. These varieties were the most commonly used minerals whether in jewelry or hardstone carvings, specially in Asia and the Middle East. The Greeks thought that rock crystal quartz was fossilized ice, a belief that continued until the sixteenth century. An important nineral with profound technological applications, quartz is essential in the computer industry as it is used in silicon emiconductors (see GeoTech). Quartz is believed to amplify subtle vibrations helping to focus, direct and store energy as well as facilitate the reception of information. The Greek word crystallon means frozen drop.



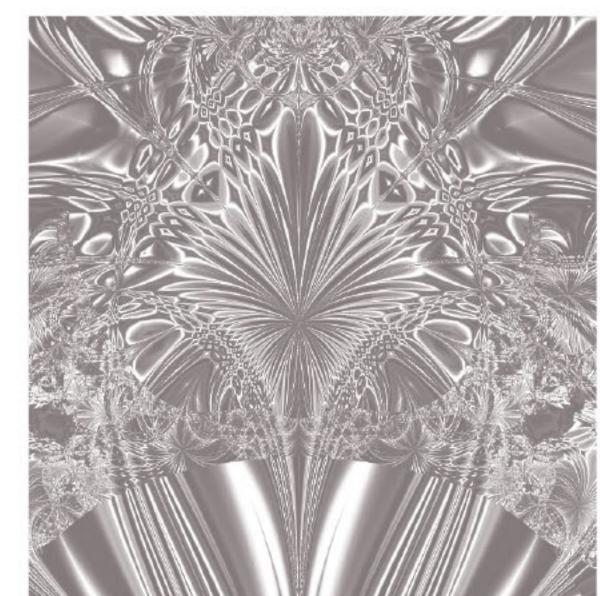
POISON = ANTIDOTE

Bezoar (bezahar in Medieval Latin, bézoard in Old French, bāzahr in Arabic, bādzahr in Persian) means counter poison or antidote. In all instances, it is a gallstone from the stomach or intestines of animals, especially ruminants such as the Arabian deer or Asian porcupine. The stone is the reaction to indigestible material whether hair, straw or plant material such as cellulose). In India they are used as a tonic and sedative; when mixed with honey they are believed to bestow clear vision, literally and metaphorically. These stones were traded between the courts of Asia, the Middle East and Europe with their value often more than that of gold. Counterfeit versions contained toxic substances such as cinnabar and quicksilver. Introduced to Western medicine by Arabian doctors during the twelfth century, they were used as an antidote to arsenic, a common poison in European courts by embedding them in goblets as well as jewellery and amulets. As a medicine they were pulverized to a powdered form and taken with wine (see Mineral Medicine). Their composition of calcium and phosphates acted as chelating agents neutralizing the effects of arsenic in particular. Bezoars are not actually minerals although they were included in an early Flemish text on mineralogy. Neither rocks nor stones,



THE WRITING OF STONES

Roger Caillois, a literary surrealist and collector of minerals, believed in the sacred as a system that exceeded current understandings of reason and psychology. In his book *The Writing of Stones*, the surrealist poetically explores the syntax or language of stones, which possess a different relation to matter, a magical relation that creates patterns and coincidence across time and space through meaningful correspondences. He insisted on attending to the marvellous in science, pointing out that the newly discovered theories of the atom had collapsed all earlier thinking about nature. Caillois expands on how a stone might, "proclaim, or illustrate, more spectacularly than is usually the case, but at the same time in a manner almost obligatorily reticent and cryptic, the existence of fundamental constants which ensure the latent continuity of the tissue of the world. Then the object makes a sign, becomes sign. It attracts onto itself that exact imagination which reveals the object more than inventing it." As magical forms of matter, stones tell us a story, reflecting back onto the viewer something of one's own material nature.



The fundamental operations of time all lie within the crystal. The Crystal-Image as described by philosopher Gilles Deleuze points to non-chronological time, those trajectories of time condensed in cinematic image-clusters but also works of art that compose and recompose both the past and the present simultaneously. Here the force or pressure of time is condensed either in a singular image or a circuit of images that begin to exchange one for the other destabilizing linear time or displacing it with psychological and prismatic folds of experience. At its core the Crystal-Image reflects back the logical contradiction that is temporal experience (see Time Crystal). The Crystal-Image shapes time as a constant two-way mirror that splits the present in two directions. In film, the crystalline is evoked in the editing of irrational cuts from one image to the next or as a false continuity that interrupts the normative linkage between two sequences. These disjunctive cuts give us a vision of psychological time. The Crystal-Image points to an inherent indiscernibility oscillating between its scientific and supernatural energies as it vibrates between the geologic and the mystical.

gaping holes for industrial applications exposing the ec



A FOREST OF SELENITE

A mine located in Naica, Saucillo in the Mexican state

of Chihuahua has forged crystals of selenite that are as large as trees, one metre in diameter and fifteen metres long. Hydrothermal fluids emanating from the magma chambers below formed these extraordinary entities. Originally, the macro crystals developed underwater in the area where sulphide saturated phreatic thermal waters came in contact with oxygen-rich cold waters, naturally infiltrating from the exterior. These singular conditions provided the habitat that gave rise to this forest of massive selenite formations. Three hundred metres below the surface, the cavern's temperature is 58°C with 99% humidity, an inhospitable atmosphere for most organic life although a recent speleological study resulted in the recuperation of pollen and microbes inside a selenite crystal. The first of the Naica caves were discovered in 1910 and almost 100 years later, another three caverns were unearthed at a different level. Other important mineral caves are in Lechuguilla, New Mexico; the Liquid Glass Digs, Israel; Santana Cavern, Brazil; Alum Caves, Island Vulcano, Sicily; and Supp-Coutum among others in Turkmenistan.



Mining extraction from the earth, usually derived

from ore, lode, vein, seam and reef deposits, removes valuable geological materials including metals, coal, oil shale, gemstones, limestone, chalk, rock salt, potash, gravel, and clay as well as petroleum, natural gas and even water. Two types of operations represent current practices; large industrial mines and small-scale, informal digging sites. Often the labour practices for these large sites are deplorable with poor adherence to health and safety guidelines. The majority of gemstones and mineral specimens are harvested as a by-product of large scale mining activities (ore, coal, copper, aluminum, gold, etc.), by accident or "hand" mining. Extraction operations usually create a negative environmental impact, both during the mining activity and after the mine has closed. Most of the global trade in these materials are generated through the industrial mines that contribute to soil contamination, erosion and sinkholes, the loss of biodiversity as well as ground water and air pollution. Assessment of these activities depends on what we understand as damage to the earth, to animals, microorganism and biodiversity in general.



OVER THE COALS

of energy unearthed from a dense and primordial underworld, and with it carbon dioxide on planet Earth. Formed from the decomposition of plant life, Earth's excrement, it is not generally classified as a mineral. It is composed primarily of carbon with trace amounts of hydrogen, oxygen, nitrogen and the mineral sulphur. There are five types of coal including anthracite, bituminous, graphite, lignite and peat. Coal is mainly found in mines. Until the eighteenth century this dark rock was burned exclusively for its carbon dense energy. Through the destructive distillation of bituminous coal a thick black liquid called coal tar was produced containing benzene, naphthalene, phenols, aniline, and many other organic chemicals. Since the 1800s, coal tar was used for medicinal purposes as well as in the pharmaceutical industry. In 1853, an English chemist working with coal tar, accidentally discovered the first synthetic dye coloured purple and called it mauveine. This led the way to dozens of other shades, all made with aniline dye from coal tar. Other coal tar by-products include benzene (perfume-making), creosote (cough syrup and the preservation of wood), naphtha (spot remover), paraffin, (candles) and toluene (saccharin).

Coal, a combustible sedimentary rock, is the largest source



BURNING VISION

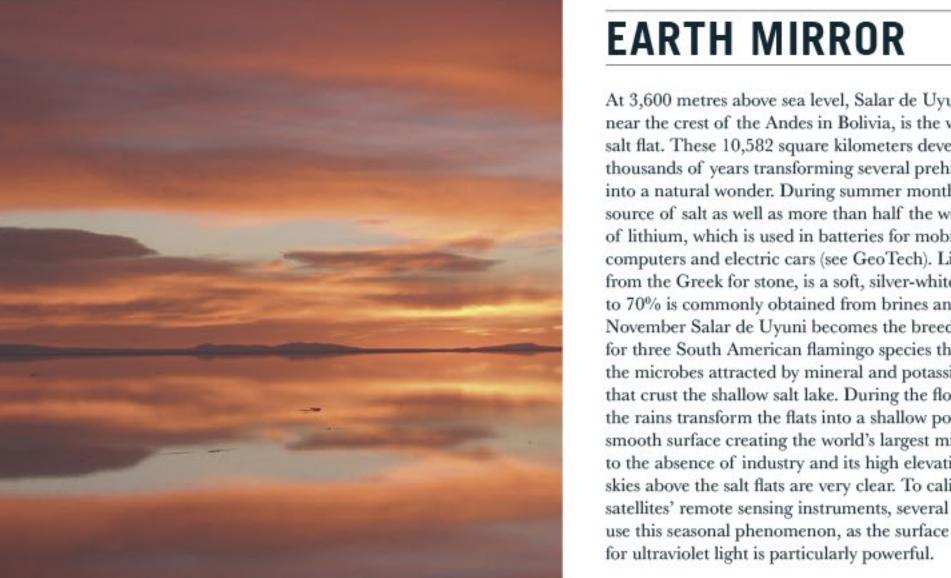
In 1789 uranium, a silvery-white metal named after the newly discovered planet Uranus was identified in the mineral pitchblende. For 150 years, it was used as a colouring agent in pottery and glass. Fast forward to WWII when the Canadian Eldorado Gold Mining Company, located near the eastern shore of Great Bear Lake, extracted uranium-bearing ore in order to supply the U.S. military with the uranium needed to produce the nuclear bombs that devastated Hiroshima and Nagasaki. The name Great Bear Lake is located on Sahtu Dene territory in the northern boreal and Arctic region. In the late nineteenth century, a Dene seer had a vision of men going into the ground and walking out with something that would rain fire down on other people. In the 1940s Dene miners were told that they were digging for a substance to cure cancer. By the 1960s, the miners who had hauled bags of the stone out of the ground began to die of lung cancer and other lung diseases. Pre WWI, female factory workers in the United States also contracted radiation poisoning from painting watch dials with self-luminous paint containing radium (the radium compound is found in uranium) when they wetted their paintbrushes with their mouths to keep them sharp. Marie Clements writes about this little-known history in her play Burning Vision.



CONFLICT MINERALS

The term "Blood diamonds" highlights the violent diamond

trade in war zones (Angola, Congo and Sierra Leone), which finance militias. Conflict minerals refer to the products derived from similar activities involving other natural resources. The four most commonly mined conflict minerals most of which are extracted from the Congo are cassiterite (for tin), wolframite (for tungsten), coltan (for tantalum), and gold ore (see GeoTech). In addition to feeding global jewellery companies, conflict minerals are also used in the manufacture of a variety of electronic devices such as mobile phones, laptops, etc. Miners are usually "hired" at gunpoint and working conditions are extreme frequently leading to death. Insurgents use tactics such as rape and other forms of violence to control the local population and destroy the social fabric. It is often difficult to trace these conflict minerals as they pass through the hands of numerous middlemen by way of neighbouring countries such as Angola, Burundi, Central African Republic, Republic of Congo, Rwanda, Sudan, Tanzania, Uganda, and Zambia. Governments are attempting to legislate due diligence with regard to tracing the supply chain. On a smaller scale, many businesses and institutions are demanding that conflict free minerals are used in their electronic devices heralding perhaps a new direction in industrial mining.



At 3,600 metres above sea level, Salar de Uyuni, located near the crest of the Andes in Bolivia, is the world's largest salt flat. These 10,582 square kilometers developed over thousands of years transforming several prehistoric lakes into a natural wonder. During summer months, it is a source of salt as well as more than half the world's supply of lithium, which is used in batteries for mobile phones, computers and electric cars (see GeoTech). Lithium, from the Greek for stone, is a soft, silver-white metal: 50 to 70% is commonly obtained from brines and clays. In November Salar de Uyuni becomes the breeding ground for three South American flamingo species that feast on the microbes attracted by mineral and potassium deposit that crust the shallow salt lake. During the flooding seasor the rains transform the flats into a shallow pool with a smooth surface creating the world's largest mirror. Due to the absence of industry and its high elevation, the skies above the salt flats are very clear. To calibrate their satellites' remote sensing instruments, several government use this seasonal phenomenon, as the surface reflectivity