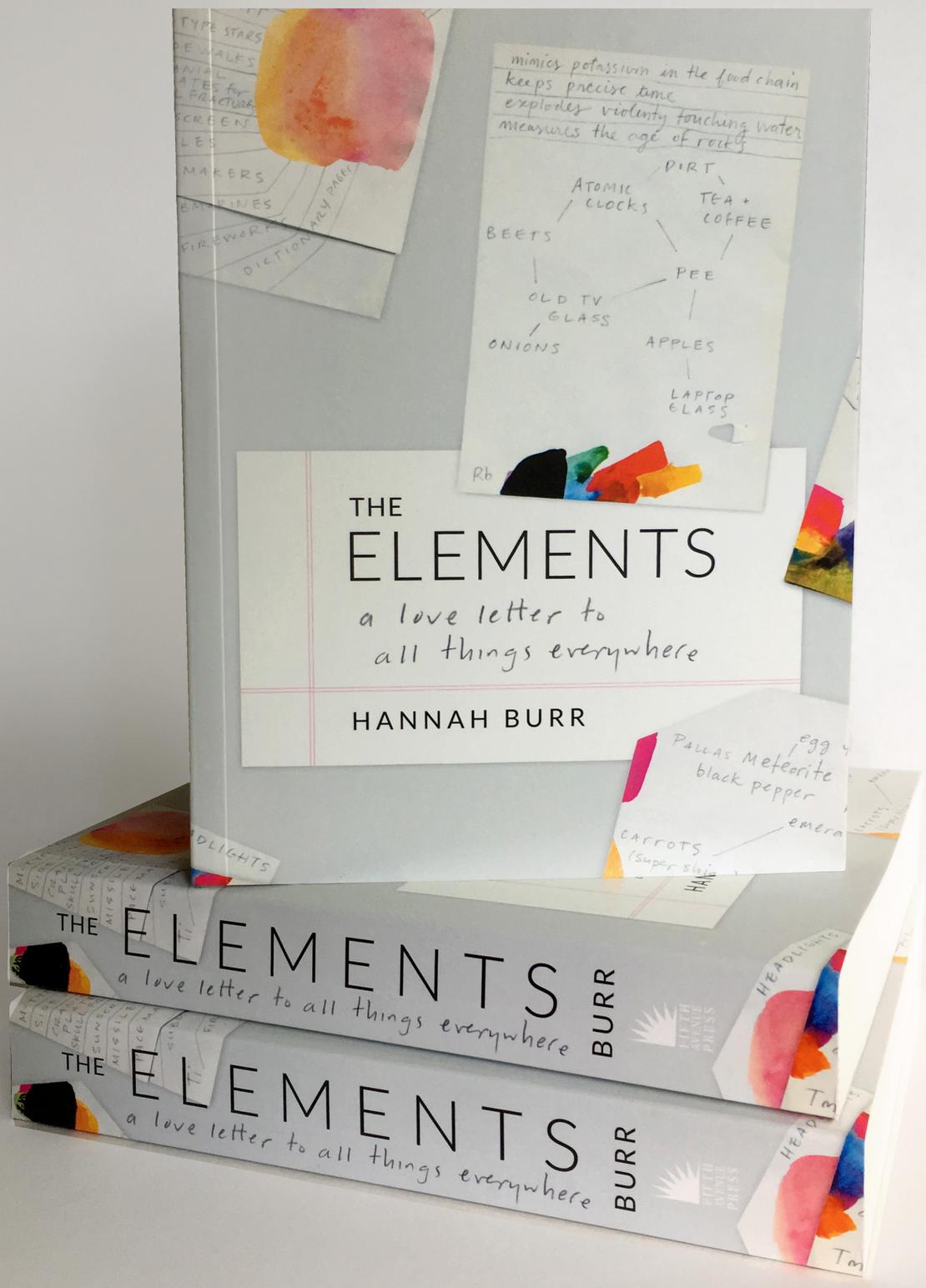

THE ELEMENTS: A LOVE LETTER TO ALL THINGS EVERYWHERE

HANNAH BURR

An artist's book about the periodic table and our inseparability from everything

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An artist's book about the elements of the periodic table and our inseperability from everything, free of scientific jargon and the expert lens.
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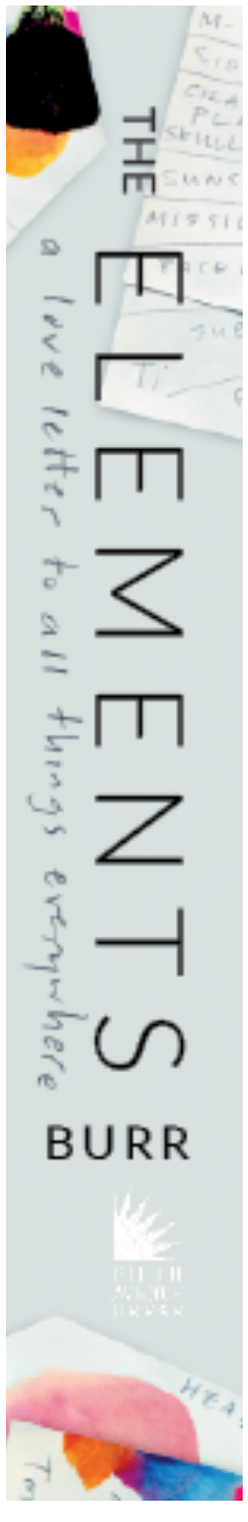
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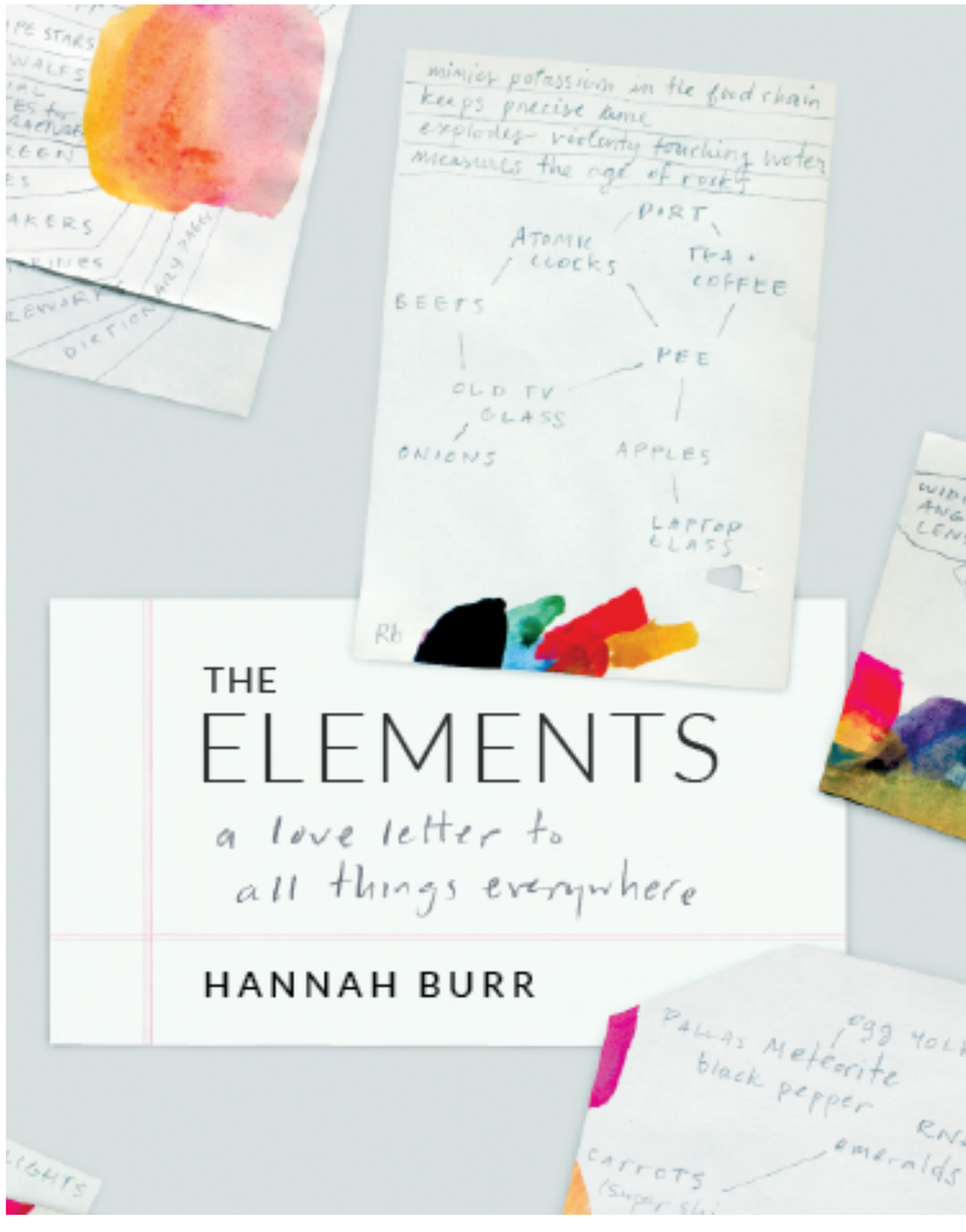
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The Elements:
a love letter to all things everywhere

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THE ELEMENTS

A LOVE LETTER TO ALL THINGS EVERYWHERE

DIRECTORY OF ELEMENTS

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From the first, not a thing is.

– HUI NENG

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There's no way to remove the observer – us – from our perceptions of the world.

– STEPHEN HAWKING

Every atom in your body was once inside a star that exploded...the atoms in your left hand probably came from a different star than in your right hand, because 200 million stars have exploded to make up the atoms in your body.

– CARL SAGAN

The universe is the smallest divisible unit.

– GEORGE SHEEHAN

INTRODUCTION

This book is the project of a contemporary artist. It is a playful re-encounter with everything around you. It reintroduces the world of stuff via the elements of the periodic table. These are the unique ingredients that comprise everything in the known universe, the primary content of all matter, including the taste in your mouth and the folds of your eyelids.

In this book you will **not** find

- The names, dates and stories of men of science
- Latin roots of element names or stories of their discovery
- Scientific jargon, expert language or math equations

The information in this book is yours – it is about what you and what everything around you are made out of.

When the brain spins stories of problem, worry, loneliness or doom (as it does), please open to any page. Look at the colors – let them seep in. These 94 ingredients suggest some astonishing things about you. The farthest reach of space, it turns out, is your birthplace. The ocean is what you carry around in your veins. You are not outside of anything, nor as separate as language and convention indicate. May you recall here the incredible unlikelihood of your alive state, your very life.

Every atom belonging to me as good belongs to you.

– WALT WHITMAN

THE PERIODIC TABLE OF ELEMENTS

1 H Hydrogen																	2 He Helium
3 Li Lithium	4 Be Beryllium											5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon
11 Na Sodium	12 Mg Magnesium											13 Al Aluminum	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon
19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton
37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon
55 Cs Cesium	56 Ba Barium	57–71	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon
87 Fr Francium	88 Ra Radium	89–103	104 Rf Rutherfordium	105 Db Dubnium	106 Sg Seaborgium	107 Bh Bohrium	108 Hs Hassium	109 Mt Meitnerium	110 Ds Darmstadtium	111 Rg Roentgenium	112 Cn Copernicium	113 Nh Nihonium	114 Fl Flerovium	115 Mc Moscovium	116 Lv Livermorium	117 Ts Tennessine	118 Og Oganesson

57 La Lanthanum	58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	61 Pm Promethium	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium
89 Ac Actinium	90 Th Thorium	91 Pa Protactinium	92 U Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium

OVERVIEW

HOW ELEMENTS HAPPEN

THE ELEMENT HYDROGEN MAKES UP 75% OF ALL ATOMS IN THE UNIVERSE. ALL HYDROGEN RESULTED FROM THE BIG BANG, 13.8 BILLION YEARS AGO

H, He, Li, Be

THE BIG BANG

The explosion that is said to have begun the universe, about 13.8 billion years ago

After the Big Bang cooled down, atoms of hydrogen and helium formed, with trace amounts of lithium and beryllium: the four lightest elements

Eventually, denser pockets of gas collapsed under their own gravity and produced stars

THE REST OF THE ELEMENTS FORM AS STARS BURN OUT, EXPLODE, COLLIDE WITH ONE ANOTHER, AND AS COSMIC RAYS HIT STUFF

MAIN SEQUENCE STAR

(LOW MASS STAR)

Ranges from 1/10th to 200X the mass of our sun

90% of all stars are this type, including our sun

MASSIVE STAR

8 to 50X the mass of our sun, these stars burn bright, fast, hot and die young, collapsing and exploding

The hotter stars burn, the brighter and bluer they appear

RELEASED IN TYPE II SUPERNOVA EXPLOSIONS:

* **C, N, O,** F, Ne, **Na, Mg,** Al, **Si, P, S, Cl,** Ar, **K, Ca,** Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Ge, As, **Se,** Br, Kr, Rb, Sr, Y, Zr, Np

RED GIANT STAR

(DYING LOW MASS STAR)

Dims and becomes redder as it burns through its helium

TYPE II SUPERNOVA

(EXPLODING MASSIVE STAR)

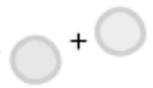
How massive stars meet their end: a violent and massive explosion

RELEASED AS RED GIANT STARS BURN:

Li, **C, N,** Sr, Y, Zr, Nb, **Mo,** Ru, Rh, Pd, Ag, Cd, In, **Sn,** Sb, Te, **I,** Xe, Cs, Ba, Hf, Ta, W, Re, Os, Ir, Pt, Au, Hg, Tl, Pb, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu

WHITE DWARF

When the helium is spent, the outer shell blows away (a nebula), and only the core remains



MERGING NEUTRON STARS

A neutron star is a small and dense star, the collapsed core of a massive star

When two neutron stars get into close orbit, they collide and produce either a black hole or a bigger neutron star

CREATED AS NEUTRON STARS MERGE:

Nb, **Mo,** Ru, Rh, Pd, Ag, Cd, In, **Sn,** Sb, Te, **I,** Xe, Cs, Ba, Hf, Ta, W, Re, Os, Ir, Pt, Au, Hg, Tl, Pb, Bi, Po, At, Rn, Fr, Ra, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Ac, Th, Pa, U, Np, Pu

PLANETARY NEBULA

(STAR NURSERIES)

Clouds of dust and gas where stars both die and start to form

Stars are always burning out and being recreated in nebulae

CREATED AS WHITE DWARFS EXPLODE:

Si, **S, Cl, K, Ca, P,** Ar, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn

EXPLODING WHITE DWARF

When another star gets close to a white dwarf, they can explode

A white dwarf is roughly the volume of Earth and the mass of our sun

CREATED IN COSMIC RAY FISSION:

Li, Be, B

COSMIC RAYS

Particles that bounce around in space nearing the speed of light

Cosmic rays hit types of matter and cause reactions called fission

There are 118 known elements, 94 of which occur naturally on Earth.

60 of these comprise our bodies. H, N, O and C make up 94% of us.

An ATOM is the smallest unit of an element. Each element has its own unique atomic structure.

*** VITAL IN YOUR BODY**

TRACE IN YOUR BODY

YOU ARE 10% HYDROGEN

You can know reality only when you are astonished.

SARGADATTA MAHARAJ

ELEMENT SKETCHBOOK

The following sketches share a few of my very favorite and strange juxtapositions of the qualities and quirks of each element, and the objects in which they are found. There is one sketch per element and they are listed from lightest to heaviest, as they are in the periodic table. The colors and composition emerged spontaneously. The Element Index, which follows this section, provides a more detailed listing of the "where" and "what" of elements in all things.
I use both found papers and map-like legends in many art projects. The legend on the next page will help you find patterns visually in the 118 element sketches.

BORON

B

Created in cosmic ray fission

BORON

Eye wash, the fragrance of hyacinths, Pyrex glass, cleaning agent, tank armor, fake snow, ceramic glaze, cherries, detergent, Death Valley.

Fireproof, magnetic, sparkly, vital to plants.

Burns green.

TITANIUM

Ti

Created in exploding massive stars and exploding white dwarf stars

TITANIUM

Antibacterial Japanese faucets, paper, moon rock, food coloring, camping gear, spacecraft, M-type stars, sidewalks, cranial plates for skull fractures, sunscreen, missiles, pacemakers, submarines, fireworks, dictionary pages.

SELENIUM

Se

Created in exploding massive stars

SELENIUM

Garlic, thyroid, semiconductors, hair, skyscrapers, every cell in the human body, molasses, broccoli, sperm, fossil fuel, bread, lake sediment, night vision cameras, bones, old photocopies, yeast, tank slime.

Vital, smelly.

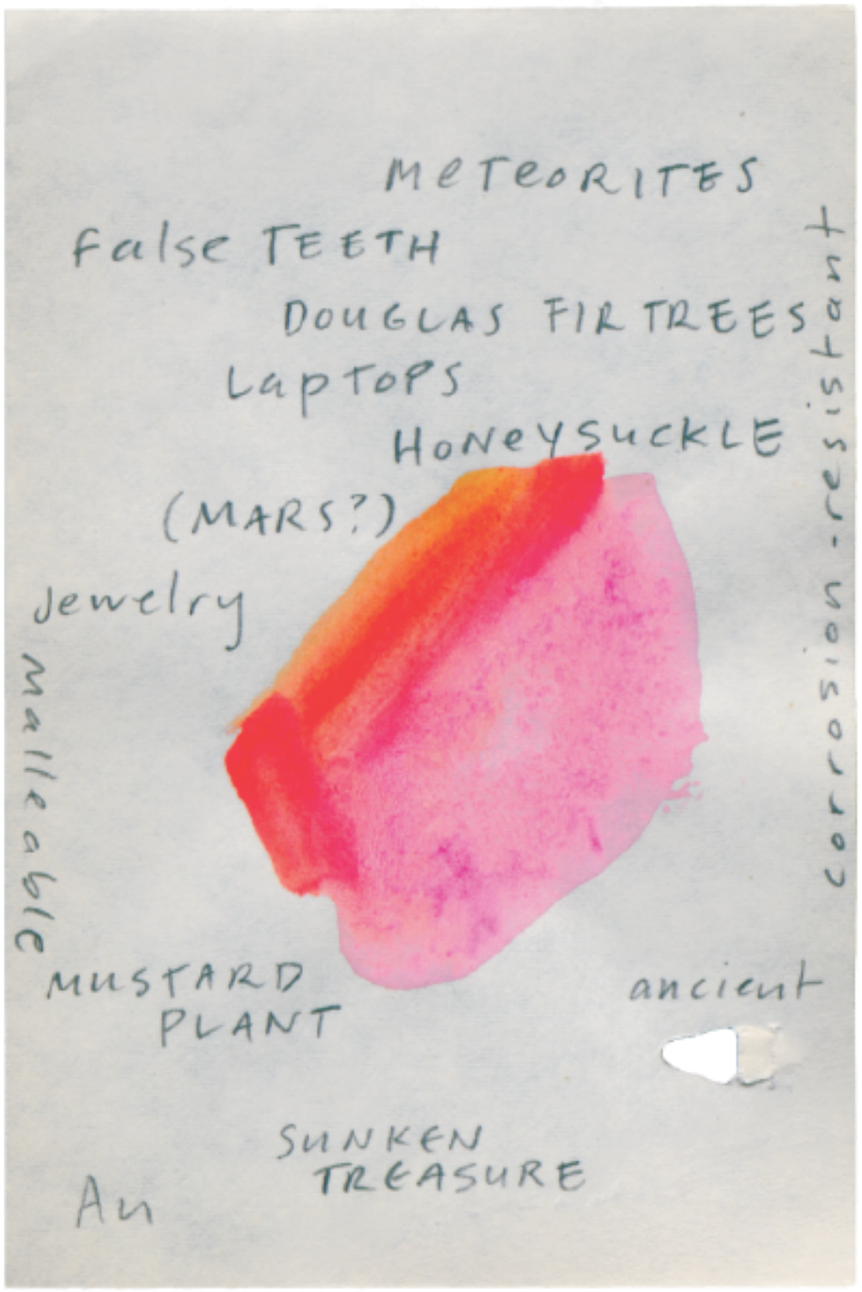
IODINE

Created in dying low mass stars and merging neutron stars

IODINE

Milk, skin, sea air, ovaries, cabbage, mouthwash, thyroid, printing dyes, daguerreotype photography, saliva.

Regulates growth, seeds clouds, controls body temperature, tests banknotes, accumulates in mushrooms.



GOLD

Au

Created in dying low mass stars and merging neutron stars

GOLD

Meteorites, false teeth, douglas fir trees, laptops, honeysuckle, jewelry, mustard plant, sunken treasure, (Mars?)

Malleable, ancient, corrosion-resistant.

A human being is part of a whole, called by us the Universe, a part limited by time and space. He experiences himself, his thoughts and feelings, as something separated from the rest. A kind of optical delusion of consciousness.

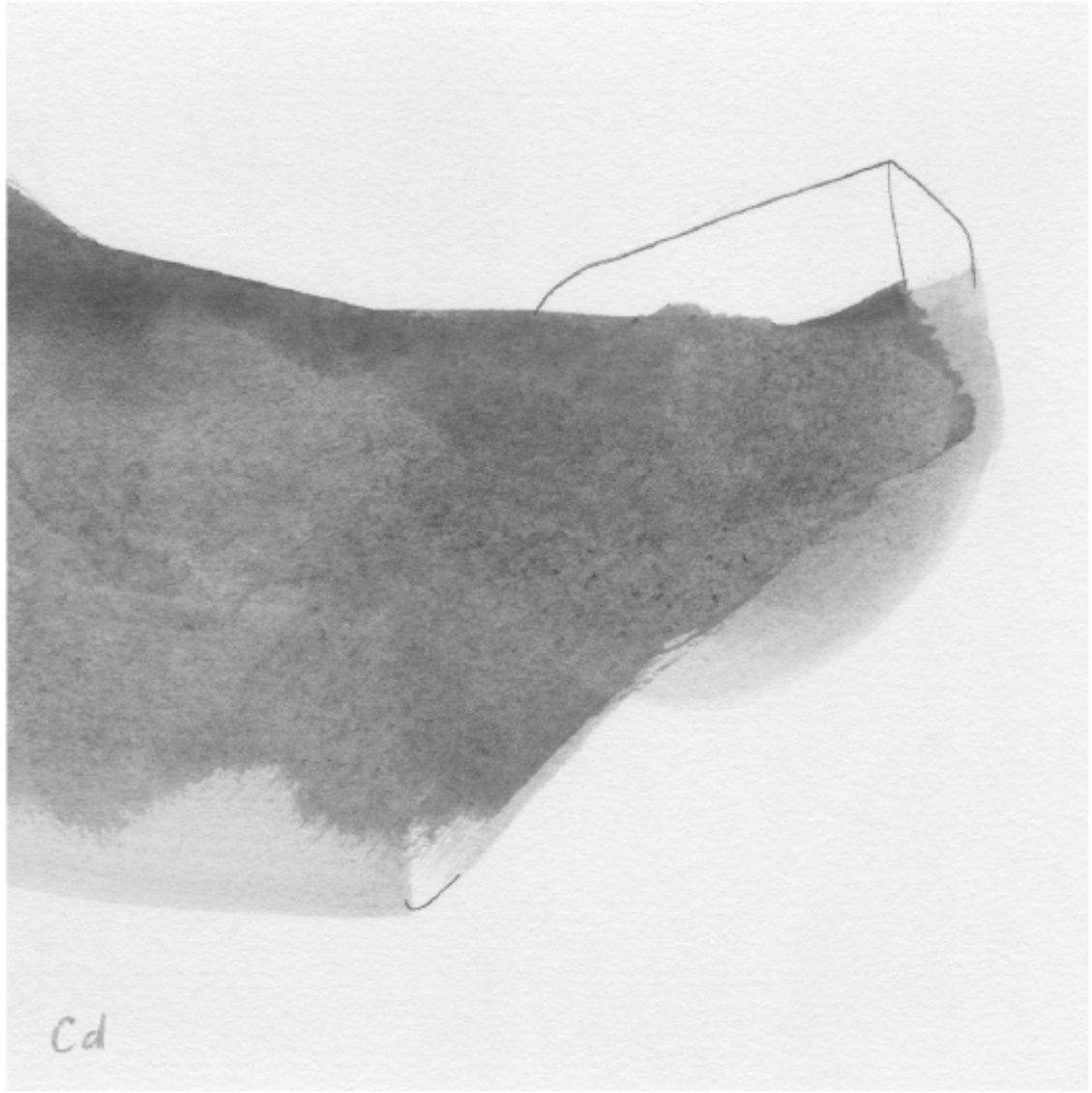
– ALBERT EINSTEIN

To know what you are, you must first investigate and know what you are not. Separate the 'I am' from 'this' or 'that' and ... feel what it means to be, just to be, without being 'this' or 'that.'

– SRI NISARGADATTA MAHARAJ

ELEMENT INDEX

This section pairs 94 abstract artworks, somewhat at random, with each naturally occurring element. Each spread includes an expanded list of objects in which this element is found, its qualities, behaviors and uses. Included are old-timey uses that have been discontinued but may still show up as an antique in your world. Also noted is the presence of each element in foods and the body. Parentheses around a noun here indicate that the element appears in minute amounts in that object, or in unusual circumstances. Elements are listed alphabetically here for easy reference.



CADMIUM

Cd

Created in dying low mass stars and merging neutron stars

QUALITIES

Silvery bluish
Red
Yellow
Soft
Toxic
Dangerous
Accumulative

BEHAVIORS

Soft enough to cut with a knife
Tarnishes in air
Similar toxicity to mercury
Essential for some marine life
One of the ten most hazardous pollutants
Remains in the human body for roughly 30 years
Mimics zinc in the body
Bad for the kidneys
Damages joints
Crop runoff lands it in foods
Ptarmigans suffer from it
Recycled from batteries

Increases in concentration as you descend the ocean floor

USES

Measure the wavelength of light
Coat steel against corrosive seawater
Make stable plastics

PRESENT IN

Zinc Ore + 22 known minerals
Fragile bones of ptarmigans
Amanita mushrooms
Cattle
Sheep
Pigs
Marine organisms

Tobacco
Electronic devices
Vitreous enamels
Zinc mines
Airplane landing gear

PRESENT IN

Orange, red, brown + yellow pigments
Solar panels
Printing inks
Rubber
Nickel cadmium batteries
Plastics

Rice
Lettuce
Spinach
Cabbage
Turnips
Corn
Beans
Potatoes
Shellfish
Livers + kidneys of cows + pigs

WAS IN

Old lead

Sketch p116

COBALT

Co

Created in exploding massive stars and exploding white dwarf stars

QUALITIES

- Rare
- Essential
- Hard
- Lustrous
- Silvery-gray
- Deep blue
- Distinctive
- Magnetic
- Sensitive

BEHAVIORS

- Remains unseen until warmed
- Stable in air
- Essential to everything that walks, crawls, flies or swims
- Unaffected by water
- Slowly attacked by acids
- Can be magnetized
- Colors diamonds blue
- Essential in minute amounts
- Emits toxic fumes

USES

- Help animals metabolize
- Convert gas to liquid fuel
- Treat cancer
- Check for cracks in metal vats
- Dry inks, paints and varnishes faster
- Sterilize and pasteurize foods
- Sterilize medical supplies + waste

PRESENT IN

- Meteorites
- Oceans
- 59 known minerals
- Blue-green algae
- Soil
- Grasses
- Violets
- Myrtle

USES

- Invisible ink
- Venetian blue glass
- Foam stabilizers in beer
- Sevres, Thenard + Cobalt Blue pigments
- Prosthetics
- Jet engines
- High-temp cutting tools
- Enamelware

PRESENT IN

- Dental implants
- Jewelry
- Tank fill-height switches
- Razor blades
- Mobile phones
- Electric cars
- Eye drops
- Hard drives
- Corn
- Lettuce
- Oranges
- Apples
- Legumes
- Vitamin B12
- Seafood
- Eggs

WAS IN

- Artificial flowers that changed color with weather (1800s)
- Blue glass
- Laundry bluing
- Land + sea mines (the Blitz)
- Persian jewelry (Bronze Age)
- Pompeii ruins, 79 AD
- Tang + Ming Dynasty china

Sketch p74

IODINE

Created in dying low mass stars and merging neutron stars

QUALITIES

Purple
Brown
Black
Shiny
Non-metallic
Solid
Heavy
Vital

BEHAVIORS

Forms black crystals and purple vapors
Essential to all animals
Fungi accumulate it
Plants absorb it through atmosphere or soil
Used with silver to seed clouds
Lack of it leads to cretinism + goiter
Its vapors irritate the eye
Linked to deficiency diseases
Released in nuclear accidents
Not essential to plants

USES

Regulate growth
Control body temperature
Develop the brain
Test for counterfeit banknotes
Make rain
Kill germs
Purify water
Treat wounds
Treat prostate cancer + thyroid cancer
Screen for vaginal + cervical problems
Make arty photographs

PRESENT IN

Seaweed
The atmosphere of coastal regions
Soil
22 known minerals
Fungi
Seawater, brine
Rivers

Epidermis (skin)

PRESENT IN

Thyroid gland
Salivary gland
Pituitary gland
Stomach
Ovaries

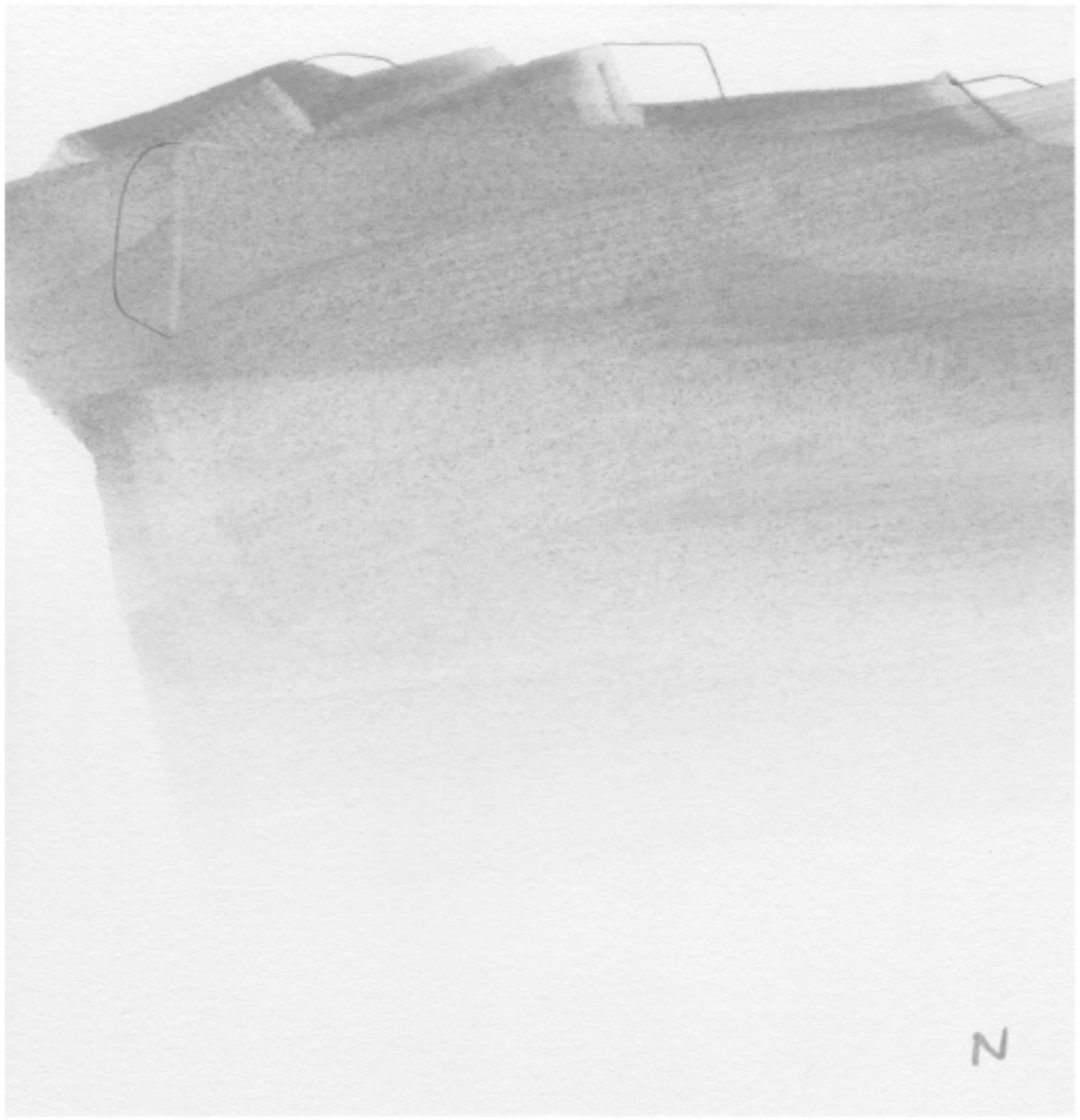
Yellow antiseptic
Cattle feed
Printing agents + dyes
Contrasting agents
Drugs
Soil fumigants
Radioactive tracers in medicine
Mouthwash
Disinfectant

Milk
Seafood
Table salt
Cabbage
Onions
Mushrooms
Rice

WAS IN

Daguerreotype photography

Sketch p126



NITROGEN

N

Created in dying low mass and exploding massive stars

QUALITIES

Colorless
Odorless
Abundant
Inert
Explosive
Gaseous
Tasteless

BEHAVIORS

Needed by every living thing
Part of the genetic code
With oxygen, is a pollutant
Slightly lighter than air

USES

Inflate tires
Preserve things
Boost crop yields
Make cryogenics possible: freeze blood, eggs and other genetic material
Lower blood pressure
Relax muscles
Make positron emission photos
Refine oil
Make ammonia

PRESENT IN

Interstellar space
Atmosphere of Saturn's moon, Titan
Mars' atmosphere

Earth's atmosphere
Thunderstorms
Air
Greenhouse gases
Rain
Seawater
Poop
Plant debris
Algae
Microbes in deep sea, hydrothermal vents
Wood
Vegetation
People, alive and dead
Some rare minerals

Enzymes
Hemoglobin
Gut microbes

PRESENT IN

Brain
Neuro-transmitters
Protein
Amino acids
DNA

Whipped cream cans
Rocket engine fuel
Airbags
Laughing gas
Beer bar taps
Gunpowder
Saltpeter
PET scans
Deep sea divers' gas
Drugs for angina
Ultra-smooth ice cream
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Drinking water

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