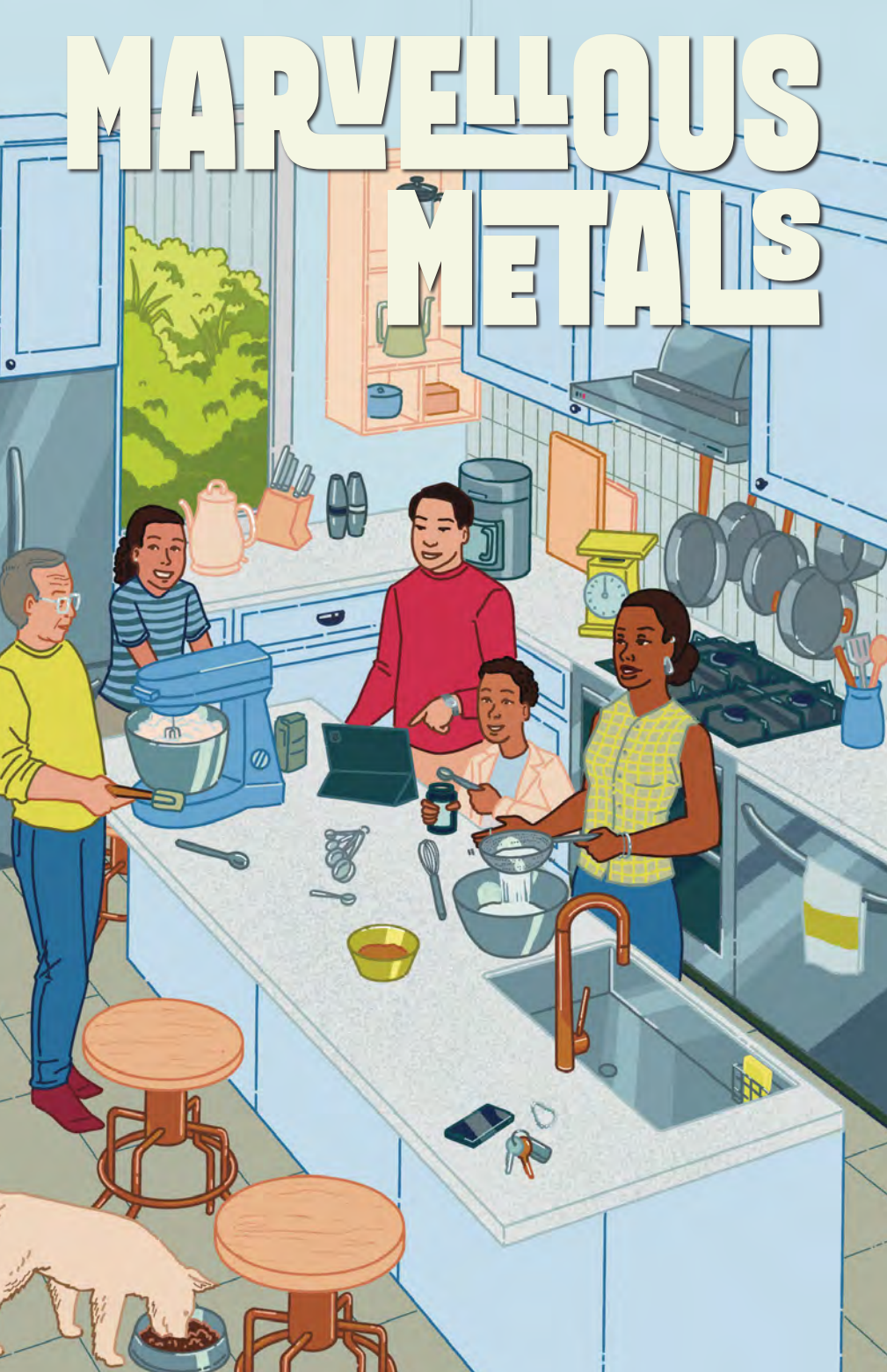
MARVELLOUS METALS



FROM ROCK TO YOUR HOUSE

Here's how metals end up in the things you use every day.

A geologist explores, looking for rocks that contain useful ore.

Ore is a rock that contains valuable **minerals** that can be processed to make metals or other useful things.

A **mining** company brings the ore to the surface or extracts it from an open pit.

Minerals are solid chemical compounds like copper sulphide and aluminum oxide, or pure elements like gold or diamond.

Arden Taylor

CANADIAN INNOVATORS

André Laplante studied the recovery of gold that is combined with other minerals, and invented methods used around the world. **Janusz Laskowski** studied the use of flotation to concentrate minerals. Both of these scientists taught at Canadian universities. By 1954, **Gerry Heffernan** had perfected the idea of a mini-mill that reused scraps left over from steel production. In the 1950s, **Bob Lee** invented an effective way to stir steel using bubbles. **Vladimir Mackiw** and **Frank Forward** made processing nickel ore more environmentally friendly with their pioneering work in the 1950s and 1960s.

Mineral processors crush and grind the ore and float or use strong magnets to separate the minerals from the non-valuable rock.

Metallurgists mix minerals with chemicals, dissolve them or heat them to melt them and further refine them.

Materials scientists, engineers, designers and other specialists work in laboratories to develop processing methods. These methods are used in the factories that make metals and different metal objects for daily life.

METALS MATTER

Modern life uses metal in all kinds of ways.

Copper

Not only does copper allow electricity to move well (an ability known as conducting), it's widely available, making it affordable. It's also easy to work with. For all those reasons, it's used for all kinds of things. For instance, the wiring behind the walls of your home is likely made of copper. Copper is also easy to recycle and so can be used over and over again.

Imagine how much time people used to spend carrying water for drinking, washing, cooking and cleaning. Copper wiring conducts the electricity that runs the pumps that move water into our homes. Bonus: That water often runs through copper pipes!

The buildings on Parliament Hill in Ottawa have copper roofs. (Copper lasts a long time, no matter the weather.) They started out shiny, but the copper created a thin protective layer after being exposed to air, rain and snow. That layer gradually turned dark brown and eventually green. This natural green protective coating is known as verdigris.

Copper is an essential part of wiring for solar panels and electric cars.

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For more than 5,000 years, Indigenous Peoples have made useful and beautiful objects out of copper. From Mi'kma'ki to the Great Lakes to the Far North, they made spear points, knives, bracelets and more. Skilled artisans of the Pacific coast nations pounded the metal into highly valued items, especially the decorated shields known as coppers.

This Inuit ulu (a special kind of knife) has a copper blade.

An alloy is made by melting pure metals together to make a stronger or more useful material. Steel, bronze and brass are examples of alloys. Solder is an alloy that is melted and used to join two metal pieces for anything from electronics to plumbing to jewellery.

Steel

This metal is iron combined with carbon, nickel and chromium to make what's known as a **compound**. People have used it for more than 2,000 years in China, Japan and Greece to make weapons, farming tools and more. By the late 1800s, innovations had made steel stronger and cheaper than ever before. That meant we could build tall apartment buildings and long bridges. It also made appliances like stoves, washers and dryers and refrigerators much more affordable.

You know what would be a lot harder without steel? Eating! Steel is used in cutlery, pots and pans, food cans, farm equipment and lots more.

Derek Tan, Museum of Anthropology at UBC, Vancouver, 1381/1, Adobe Stock

Working with metals can take people to interesting places. Mohawk (Kanien'kehá:ka) "skywalkers" from the community of Kahnawake south of Montreal are famous for their ability to work with steel beams on construction sites far above the ground. Thanks to this very specialized skill, they helped build many of the most famous structures in New York City.

In the past, factories that made steel were big polluters. The rules are stricter and the technology is better now, so there's less pollution in the air and water.

Zinc

Without a zinc coating, iron and steel would rust. This coating process is called galvanizing. Cars last twice as long now because they're made with galvanized steel. That's especially important in a country where we use so much rust-causing salt (another thing mined in Canada) on our roads. Galvanized nails and screws are everywhere. And all kinds of small parts for construction and machinery are made from zinc or zinc alloys. When it is heated to high temperatures, zinc melts and can be poured into moulds called dies in the shape of whatever part is needed.

Zinc oxide — zinc combined with oxygen — is an important ingredient in many kinds of sunscreen. It helps prevent skin damage and even cancer by shielding you from the sun's harmful rays. When you were a baby, you probably had it smeared you-know-where to prevent diaper rash. Zinc oxide also helps to heal wounds.

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Aluminum

When it's combined with other metals, aluminum is strong, long-lasting and very light. That makes it perfect for building airplanes and cars. Lighter vehicles use less fuel and therefore release less greenhouse gases. You also see aluminum in everyday things like pop cans, foil wrap, power lines and more.

Nickel

The coins we use are mostly made of nickel. The loonie is bronze on top of nickel. The centre of a toonie is mostly copper with some aluminum and a bit of nickel. The outer ring is all nickel.

Titanium

Titanium is named for the oldest Greek gods, the super-strong Titans. No surprise that this metal is also super-strong, as well as very hard and light. Most of it is used in making airplanes and spacecraft, including communication satellites, but it also turns up in medical equipment and computers. Another big use is to replace bones in joints like hips and knees when they wear out. Titanium works well with human muscles, and bacteria can't hold on to it.

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Cellphones contain many rare earth metals such as cerium, lanthanum and terbium.

Rare Earth Elements

These 17 metals are not scarce, but they occur in small amounts and are often mixed with other minerals. That makes them difficult and expensive to extract from their ores, but even so, they're becoming more important all the time. The biggest use of rare earth metals is in specialized magnets for cellphones, computers, medical equipment, electric and gas-powered vehicles and all kinds of tech items. They're necessary for wind turbines that create cleaner electricity, as well as for rechargeable batteries.

Earlier efforts at recovering rare earth metals caused a lot of pollution. Today there are strict environmental rules for mineral processing that aim to minimize environmental impact. It will be important to continue to uphold those rules with minerals and metals we need for the future.

UNDER YOUR FEET

Yukon
Copper, gold, silver, tungsten

Northwest Territories
Bismuth, cobalt, copper, rare earth elements

Nunavut
Gold, iron, nickel, cobalt, copper, platinum group metals

British Columbia
Aluminum, bismuth, cobalt, copper, gold, indium, lead, molybdenum, zinc, rare earth elements

Alberta
Cobalt, lithium, nickel, titanium

Saskatchewan
Copper, gold, helium, potash, uranium

Manitoba
Cobalt, copper, gold, nickel, zinc

iStockphoto

No matter where you are in Canada, metals and minerals are probably being explored, mined or processed not far away. Here are just some of them.

Newfoundland and Labrador
Cobalt, gold, iron, nickel, fluorspar, antimony

Quebec
Aluminum, copper, gold, iron, lithium, nickel, niobium, platinum group metals, rare earth elements, scandium, titanium, zinc

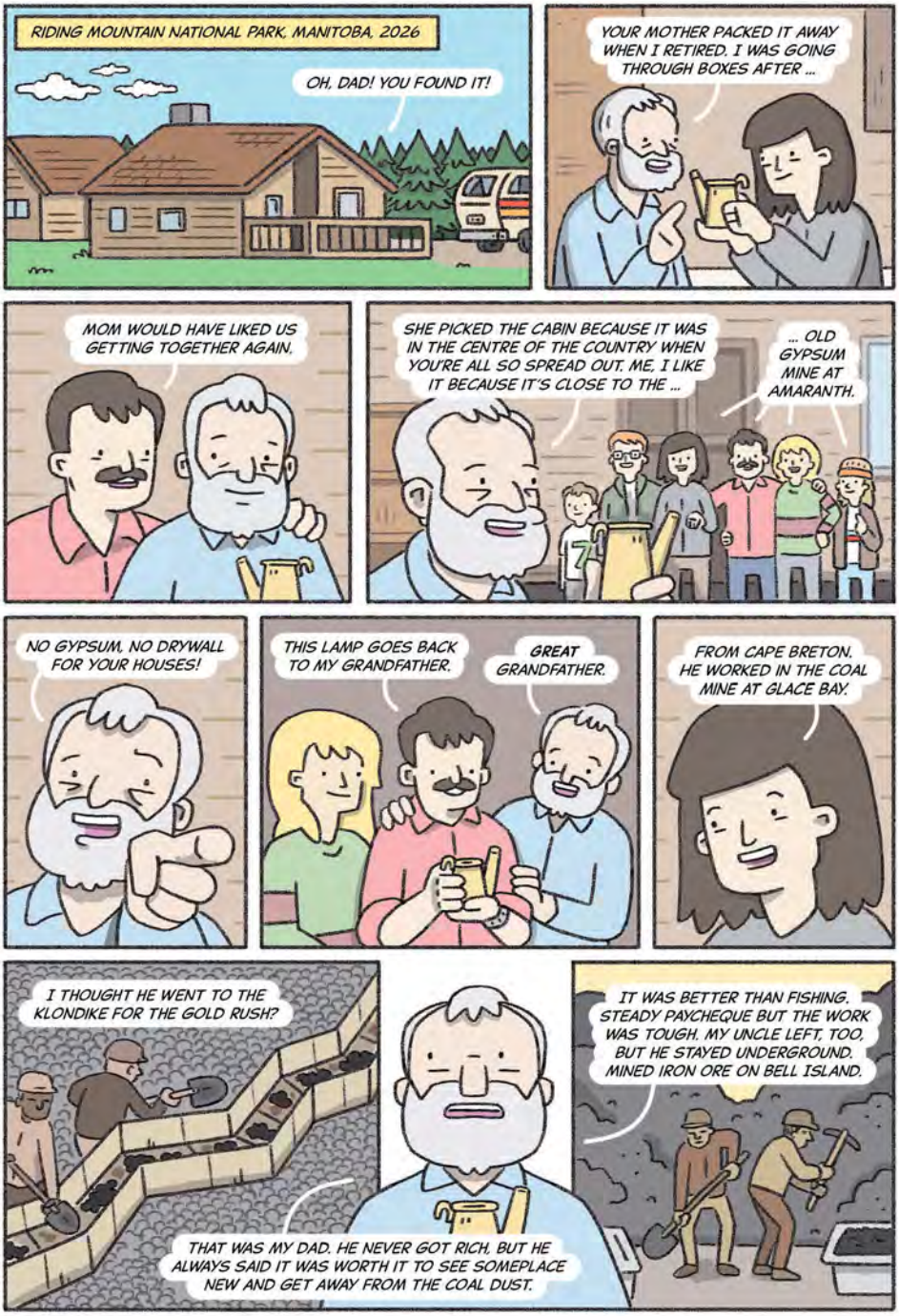
Ontario
Chromium, cobalt, copper, gold, graphite, nickel, palladium, platinum group metals, uranium, zinc

Nova Scotia
Gallium, gold, gypsum, lead, tin, tungsten

New Brunswick
Copper, gold, graphite, lead, tin, tungsten, zinc

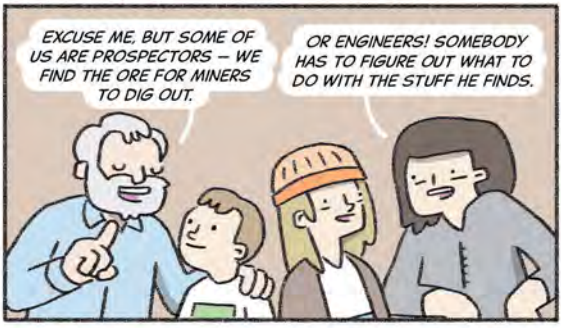
THROUGH THE YEARS

Illustrated by Ryan Harby



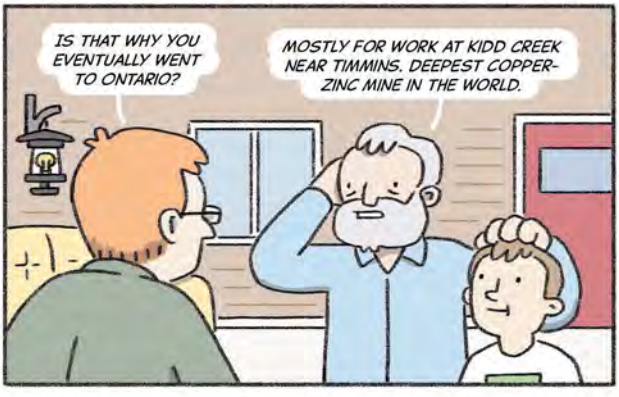
IN NEWFOUNDLAND?
YEP. HARD WORK, BRAVE MEN. THE IRON WENT BACK TO SYDNEY FOR PROCESSING, SO HE STAYED CONNECTED TO CAPE BRETON, IN A WAY.

IS EVERYBODY IN THIS FAMILY A MINER?
PRETTY MUCH.

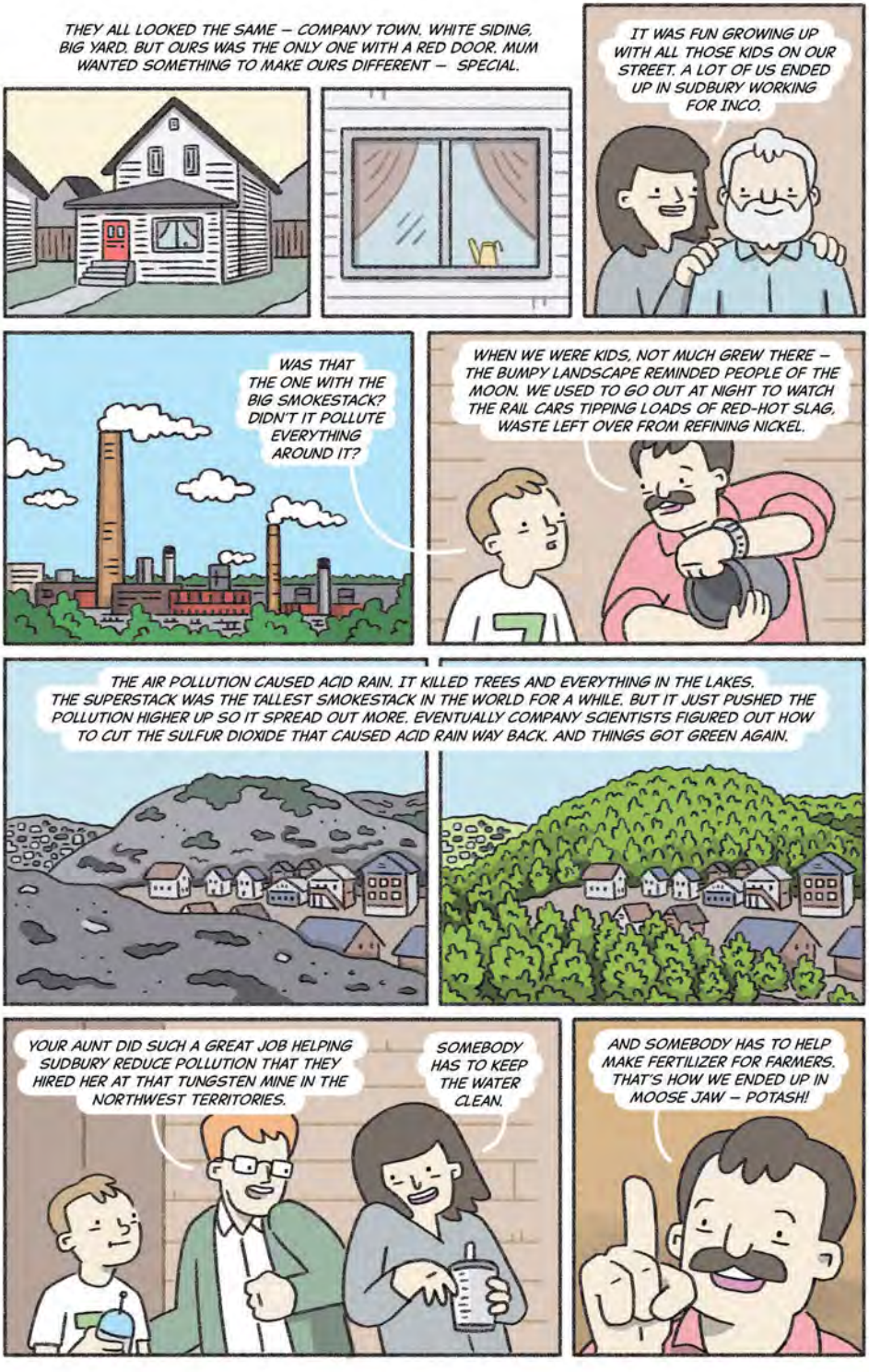

EXCUSE ME, BUT SOME OF US ARE PROSPECTORS — WE FIND THE ORE FOR MINERS TO DIG OUT.
OR ENGINEERS! SOMEBODY HAS TO FIGURE OUT WHAT TO DO WITH THE STUFF HE FINDS.

THE LAMP?
IT'S BEEN PASSED DOWN FOR AT LEAST A CENTURY.
IT'S SEEN A LOT.

WE WERE IN QUEBEC FOR THE 1949 STRIKE. I WAS JUST A YOUNG GUY, NEW TO THE COMPANY. I HAD NO IDEA THE ASBESTOS FIBRES THEY WERE MINING WERE SO HARMFUL. I THOUGHT THE WORKERS WERE JUST GREEDY, GOING ON STRIKE FOR A DOLLAR AN HOUR RAISE. THE OWNERS BROUGHT IN PEOPLE TO TAKE THEIR JOBS. THE WORKERS PROTESTED SO THE COPS ROUGHED THEM UP. NOBODY WON, BUT THE WORLD LEARNED ABOUT THE HAZARDS OF ASBESTOS.
SCABS


IS THAT WHY YOU EVENTUALLY WENT TO ONTARIO?
MOSTLY FOR WORK AT KIDD CREEK NEAR TIMMINS. DEEPEST COPPER-ZINC MINE IN THE WORLD.

DO YOU REMEMBER OUR HOUSE THERE?


THEY ALL LOOKED THE SAME — COMPANY TOWN. WHITE SIDING, BIG YARD. BUT OURS WAS THE ONLY ONE WITH A RED DOOR. MUM WANTED SOMETHING TO MAKE OURS DIFFERENT — SPECIAL.
IT WAS FUN GROWING UP WITH ALL THOSE KIDS ON OUR STREET. A LOT OF US ENDED UP IN SUDBURY WORKING FOR INCO.
WAS THAT THE ONE WITH THE BIG SMOKESTACK? DIDN'T IT POLLUTE EVERYTHING AROUND IT?
WHEN WE WERE KIDS, NOT MUCH GREW THERE — THE BUMPY LANDSCAPE REMINDED PEOPLE OF THE MOON. WE USED TO GO OUT AT NIGHT TO WATCH THE RAIL CARS TIPPING LOADS OF RED-HOT SLAG, WASTE LEFT OVER FROM REFINING NICKEL.
THE AIR POLLUTION CAUSED ACID RAIN. IT KILLED TREES AND EVERYTHING IN THE LAKES. THE SUPERSTACK WAS THE TALLEST SMOKESTACK IN THE WORLD FOR A WHILE. BUT IT JUST PUSHED THE POLLUTION HIGHER UP SO IT SPREAD OUT MORE. EVENTUALLY COMPANY SCIENTISTS FIGURED OUT HOW TO CUT THE SULFUR DIOXIDE THAT CAUSED ACID RAIN WAY BACK. AND THINGS GOT GREEN AGAIN.
YOUR AUNT DID SUCH A GREAT JOB HELPING SUDBURY REDUCE POLLUTION THAT THEY HIRED HER AT THAT TUNGSTEN MINE IN THE NORTHWEST TERRITORIES.
SOMEBODY HAS TO KEEP THE WATER CLEAN.
AND SOMEBODY HAS TO HELP MAKE FERTILIZER FOR FARMERS. THAT'S HOW WE ENDED UP IN MOOSE JAW — POTASH!

THE FAMILY IN THIS COMIC ISN'T REAL, BUT THEIR LAMP IS. THIS BRASS LAMP IS FROM THE COLLECTION OF OBJECTS USED IN MINING AT THE CANADA SCIENCE AND TECHNOLOGY MUSEUM IN OTTAWA.

INGENIUM 2014.0247

FIND YOUR PLACE

From searching for minerals to protecting the environment to processing metal and much more, there are all kinds of careers you can choose from.

Indira V. Samarasekera, President Emeritus, University of Alberta; Order of Canada
"I became fascinated with metallurgical engineering, especially how metals are processed, after my undergraduate degree in mechanical engineering. Metals processing has given me a great career. Standing in a steel plant, watching the ladle with steel at 1600C and all the chemistry involved in making a perfect grade of steel was exciting."

Leo W. Gerard, Union Leader
Leo Gerard followed in his father's footsteps at 18, joining Steelworkers Local 6500 at Inco in Sudbury. He rose to become a national leader of the union and eventually its international president. Gerard helped strengthen workplace health and safety, gender equality, labour rights, pay and pensions while working for global solidarity, fair trade and social justice.

Taryn Roske, JBS Operator III, Cameco Cigar Lake Operation, Saskatchewan
"The best thing you can do for yourself in your career is advocate for yourself. No one knows what you're capable of but you!" Roske operates remote-controlled equipment that uses high-pressure water jets used in mining, known as a jet boring system (JBS).

Boyd Davis, Principal, Kingston Process Metallurgy Inc.
"I have always been entranced by the fact that 100 or so elements form the building blocks for the universe. The challenge of making the world a better place with metallurgical processes is very difficult, but never boring. Without metals, we would still be in the stone age!"

Photos courtesy of participants

Roussos Dimitrakopoulos, Professor of Mining Engineering, McGill University

"Growing up near ancient mines in Greece, to learn about minerals and exploring the world became my passion, which led me to Canada and becoming a mining engineer. With my students and worldwide networking, we solve real problems and help to increase production from mines safely and efficiently while ensuring sustainability, responding to the needs for more metals to build homes, schools, clean energy and much more. That makes me proud!"

Farzaneh Sadri, Assistant Professor, Robert M. Buchan Department of Mining, Queen's University

"I have loved chemistry, science and solving puzzles since my childhood, and now I get to do that every day! I research and teach how to get pure metals from rocks in cleaner and smarter ways. These metals help make things like phones, batteries and cars. I love my job because every day feels like solving a new puzzle. If you like asking questions, doing experiments and discovering how things work, you can do this too!"

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Co-editors: Rebecca Dolgoy, Engin Özberk

Art director: Leigh McKenzie

Writer: Nancy Payne

Illustrator: Arden Taylor

Comic artist: Ryan Harby

Proofreader: Danielle Chartier

Translator: Marie-Josée Brière

Production designer: Olivia Guay

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MetSoc Historical Metallurgy Standing Committee

Engin Özberk, FCIM
Rebecca Dolgoy, PhD
Sam Marcuson, PhD
John Goode, FCIM, P.Eng
Konstantina Chalastara, PhD, P.Eng
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Robin Gendron, Prof. (History)
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HIDDEN METALS

There are all kinds of everyday metal objects in the comic "Through the Years" and on the cover. How many can you find?

Go back through the rest of the magazine. How many metal things can you find in total?

We spotted at least 85.

MINE EVOLUTION

Build Canada's green future through modern mining when you play Mine Evolution, a free game from Science North. Collect Earth's treasures from all over Canada to unlock new technology and build the ultimate modern mine.

Science North in Sudbury, Ont., is a great place to visit to learn about mining, minerals, metals and all kinds of other science-related subjects.

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