

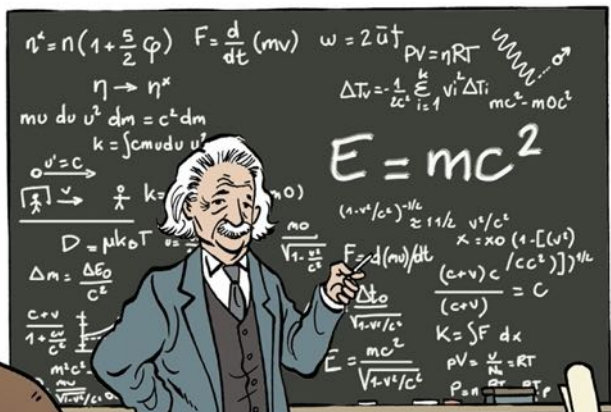


On the History Trail
with **Ariane & Nino**



1. Albert Einstein

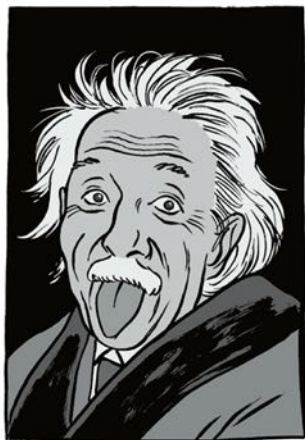
Genius Physicist

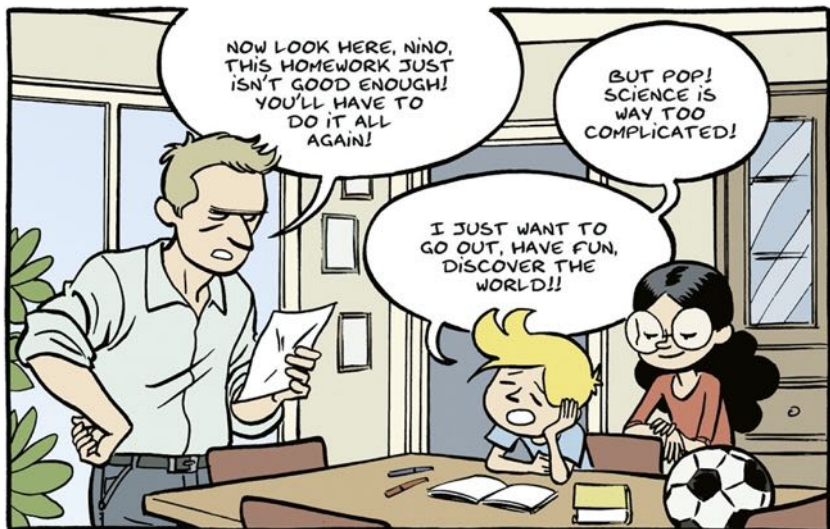


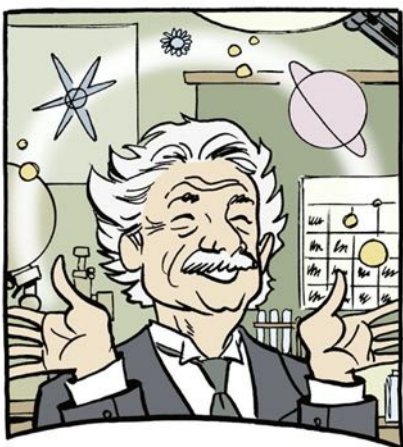
On the History Trail
with **Ariane & Nino**

1. Albert Einstein

Writer: Fabrice Erre
Artist: Sylvain Savoia







AS A PERSON, HE TRIED TO
MAKE THE HUMAN WORLD
A BETTER PLACE!



THERE'S
SOMEONE WHO DID
HIS HOMEWORK
PROPERLY!



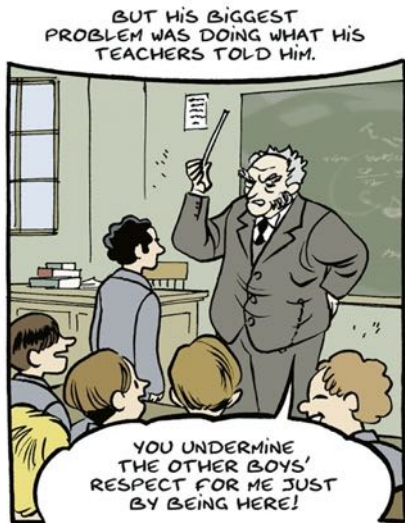
EINSTEIN LIVED AT A TIME
WHEN SCIENCE WAS MAKING
HUGE PROGRESS. IT WAS THE
SECOND INDUSTRIAL
REVOLUTION!



ELECTRICITY AND RADIO
WAVES WERE INTRODUCED,
CARS AND PLANES WERE
INVENTED.

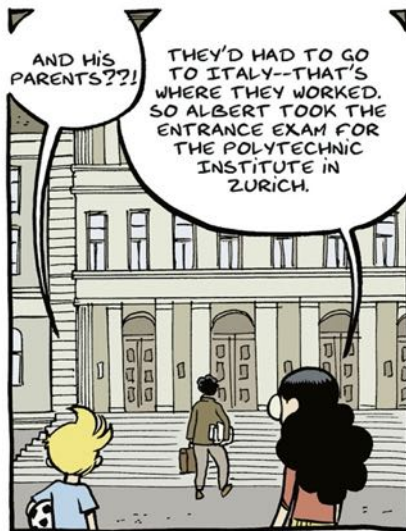


BUT IT WAS ALSO A PERIOD
OF TERRIBLE CONFLICT--THE
TWO WORLD WARS, IMPERIALISM...





THAT WAS THE START OF ALBERT'S ACTIVISM--AT THE AGE OF 15 HE DIDN'T WANT TO DO HIS MILITARY SERVICE, SO HE LEFT GERMANY FOR SWITZERLAND!



*EINSTEIN ACTUALLY SAID EVERYTHING HE SAYS IN THIS BOOK.





TO EARN A LIVING, HE HAD TO DO AN ORDINARY OFFICE JOB.



IN 1905, HE
PUBLISHED A SERIES
OF GROUNDBREAKING
ARTICLES THAT TOTALLY
CHANGED THE WAY
PEOPLE UNDERSTOOD
THE WORLD!

FIRST HE
REDEFINED THE
CONCEPT OF LIGHT.
UP UNTIL THEN, PEOPLE
THOUGHT LIGHT WAS
SIMPLY WAVES. EINSTEIN
WORKED OUT THAT IT
ALSO CONSISTS OF
PARTICLES. TODAY
THEY'RE CALLED
PHOTONS.

AND HE
CONFIRMED THAT
THE SPEED OF
LIGHT IS CONSTANT
AND CAN'T BE
PASSED--ALMOST
200,000 MILES
A SECOND!

WOW! IF MY BALL
WAS A PHOTON, NOBODY
COULD STOP IT!

THEN HE
REVOLUTIONIZED
THE IDEA OF TIME.
HE SHOWED THAT IT
VARIES ACCORDING TO
THE SPEED YOU'RE
MOVING AT. SO THE
FASTER YOU MOVE,
THE SLOWER TIME
PASSES.

FOR EXAMPLE,
I'M OLDER THAN
YOU, RIGHT? BUT IF
I WENT ON A REALLY
LONG SPACE TRIP AND
I TRAVELED REALLY
FAST, BY THE TIME
I GOT BACK TO
EARTH, YOU'D BE
OLDER THAN ME!

HUH?!
YOU'D BE
MY KID
SISTER?

YUP!

ACCORDING
TO EINSTEIN,
TIME IS NOT A
CONSTANT LIKE
THE SPEED OF
LIGHT. IT'S
RELATIVE!

THAT'S THE
"THEORY OF SPECIAL
RELATIVITY"!

FINALLY, ALBERT WORKED OUT THAT AN OBJECT'S MASS AND ENERGY ARE RELATED TO THE SPEED OF LIGHT ACCORDING TO THE FAMOUS FORMULA $E=MC^2$.

WHAT DOES THAT MEAN?

WELL, FOR EXAMPLE, THAT THERE'S ENOUGH ENERGY IN YOUR SOCCER BALL TO HEAT A HOUSE FOR HUNDREDS OF YEARS!

ENERGY

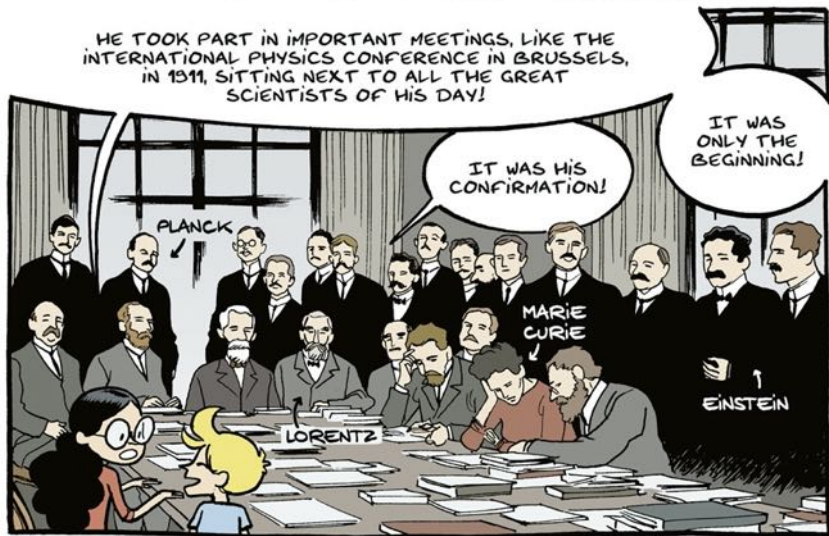
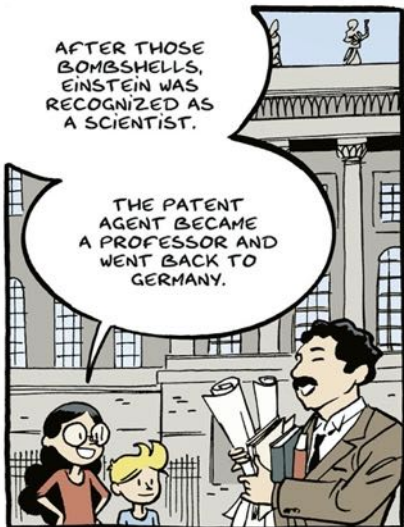
MASS

SPEED OF LIGHT

WHAT? REALLY?

YES, BUT ONLY IN THEORY. IN FACT, THERE WOULD HAVE TO BE A MASSIVE REACTION, AND THAT CAN'T HAPPEN ALL BY ITSELF.

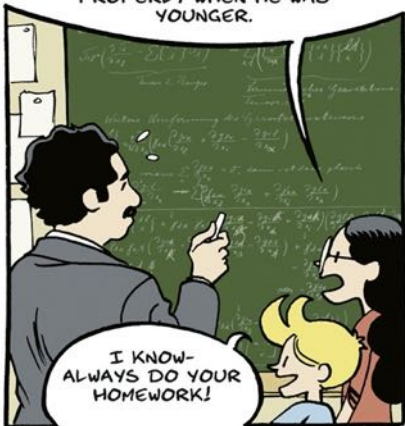
INSIDE THE SUN, THAT KIND OF REACTION GOES ON ALL THE TIME. THE SUN TRANSFORMS ITS OWN MATTER INTO ENERGY, WHICH IS WHY IT'S SO HOT AND BRIGHT!



EINSTEIN WANTED TO GO FURTHER AND PUT TOGETHER A MORE COMPLETE THEORY, BUT IT WASN'T EASY.



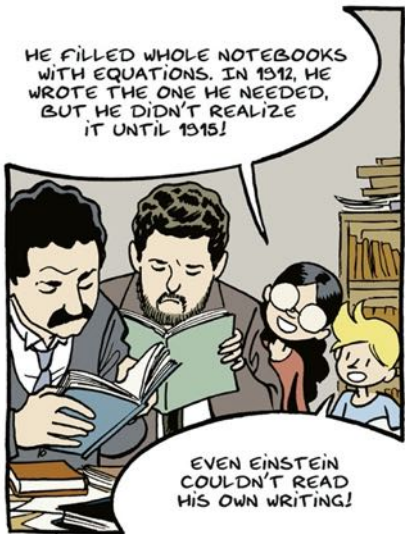
HE ALSO HAD TO LEARN ADVANCED MATH, WHICH HE HADN'T STUDIED PROPERLY WHEN HE WAS YOUNGER.



SO EINSTEIN CONTACTED AN OLD SCHOOL FRIEND, MARCEL GROSSMANN, WHO HAD BECOME A FAMOUS MATHEMATICIAN.



HE FILLED WHOLE NOTEBOOKS WITH EQUATIONS. IN 1912, HE WROTE THE ONE HE NEEDED, BUT HE DIDN'T REALIZE IT UNTIL 1915!



THEN HE PUBLISHED HIS
"THEORY OF GENERAL
RELATIVITY"...

...WHICH SAID
THAT TIME AND SPACE
COULD BE DISTORTED
BY THE MASS OF
AN OBJECT.

HUH?

C'MON, I'LL SHOW
YOU USING YOUR
SOCCER BALL.

IMAGINE THAT THE NET
REPRESENTS TIME AND SPACE.
YOUR BALL'S MADE A DENT
IN TIME AND SPACE. DO
YOU SEE IT?

THAT DENT SHOWS
THAT LIGHT HAS BEEN
BENT, AND THAT TIME
DOESN'T BEHAVE IN THE
NORMAL WAY WHEN THERE'S
A LARGE OBJECT
AROUND!

YEAH...



BUT ALL THIS WAS JUST A THEORY. EINSTEIN ONLY IMAGINED AND CALCULATED LAWS OF PHYSICS. SOMEONE HAD TO PROVE HE WAS RIGHT.



IN 1919, HIS THEORY WAS PROVEN BY AN ASTRONOMER CALLED EDDINGTON, WHEN HE MADE OBSERVATIONS DURING A SOLAR ECLIPSE. OVERNIGHT, EINSTEIN BECAME A STAR!



SO HE WASN'T ECLIPSED BY ANYONE!

FROM THEN ON HE TOURED THE WORLD, GIVING LECTURES AND INTERVIEWS... IT WAS THE FIRST TIME EVER A SCIENTIST HAD BEEN INTERNATIONALLY FAMOUS.



ALMOST AS FAMOUS AS A SOCCER PLAYER!


IN 1921, HE WON THE NOBEL PRIZE--THE ULTIMATE HONOR FOR ANY SCIENTIST.



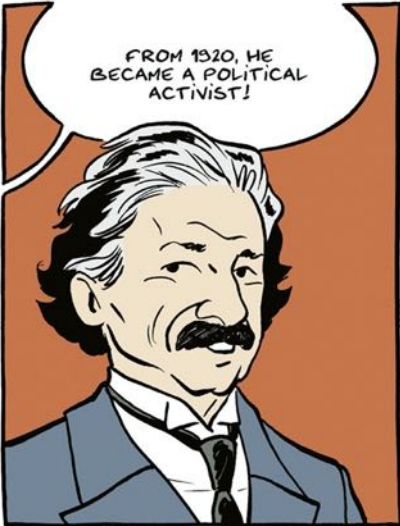
HE MET ALL KINDS OF OTHER FAMOUS PEOPLE--LIKE THE ACTOR CHARLIE CHAPLIN.

WHAT IMPRESSES ME MOST ABOUT YOUR ART IS ITS UNIVERSALITY. YOU DON'T SAY A WORD AND YET EVERYONE IN THE WORLD UNDERSTANDS YOU.

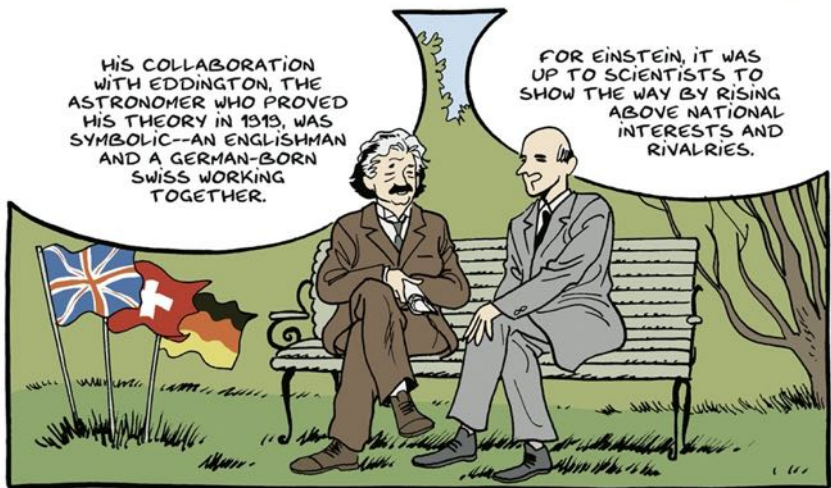
THAT'S TRUE, BUT YOU'RE EVEN MORE IMPRESSIVE. EVERYONE IN THE WORLD ADMIRES YOU AND YET NO ONE CAN UNDERSTAND A WORD YOU SAY.



LIKE CHAPLIN, EINSTEIN REALIZED THAT WITH CELEBRITY COMES RESPONSIBILITY, THAT HE HAD TO USE HIS FAME TO SUPPORT IMPORTANT CAUSES.



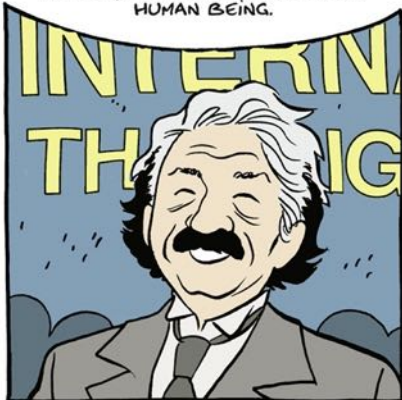
FROM 1920, HE BECAME A POLITICAL ACTIVIST!



SO HE TOOK IT UPON HIMSELF TO DENOUNCE VIOLENCE IN ALL ITS FORMS. IN 1927, HE BECAME HONORARY PRESIDENT OF THE LEAGUE AGAINST IMPERIALISM.



A YEAR LATER, HE PRESIDED OVER THE INTERNATIONAL LEAGUE FOR THE RIGHTS OF MAN, FIGHTING FOR EQUAL RIGHTS FOR EVERY HUMAN BEING.

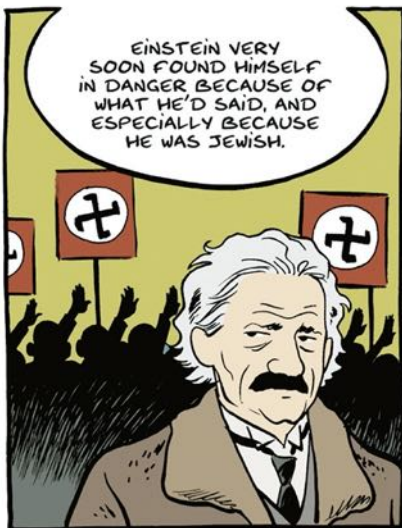


PEACE, FREEDOM FROM OPPRESSION, HUMAN RIGHTS... EVERYONE BELIEVES IN THOSE, DON'T THEY?



YOU'D THINK SO! BUT IN THOSE DAYS, IF YOU CRITICIZED ARMIES AND COUNTRIES, YOU WERE SEEN AS A TRAITOR!

EINSTEIN VERY SOON FOUND HIMSELF IN DANGER BECAUSE OF WHAT HE'D SAID, AND ESPECIALLY BECAUSE HE WAS JEWISH.





IT MEANS HATRED OF JEWISH PEOPLE, WHO WERE ACCUSED OF HAVING CAUSED GERMANY'S DEFEAT IN 1918 AT THE END OF THE FIRST WORLD WAR.



EINSTEIN'S FAMILY WAS JEWISH, EVEN THOUGH HE WASN'T PARTICULARLY RELIGIOUS, HE FOUND PEOPLE DESPISING HIM MORE THAN EVER BEFORE.



REMEMBER THAT THE NAZI PARTY WAS ON THE RISE.



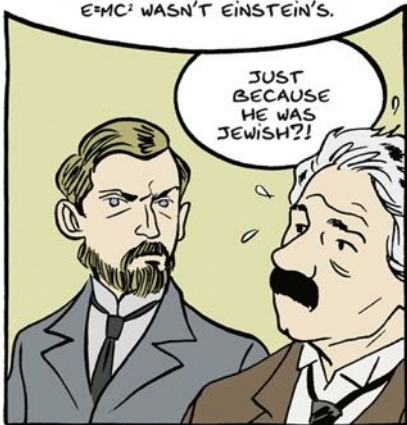
BUT PEOPLE SHOULD'VE BEEN PROUD THEIR COUNTRY HAD SUCH A FAMOUS SCIENTIST, RIGHT?

NOT EVERYONE WAS.



THE PHYSICIST PHILIPP LENARD, A NAZI SYMPATHIZER, EVEN CLAIMED THAT THE FORMULA $E=mc^2$ WASN'T EINSTEIN'S.

JUST BECAUSE HE WAS JEWISH?!



THIS SITUATION FORCED EINSTEIN TO TAKE A STAND.

THE JEWISH PEOPLE HAVE INTEGRATED INTO EUROPE (...) AND YET THEY ARE STILL REGARDED AS FOREIGNERS.

WE JEWS MUST REMIND OURSELVES THAT WE ARE AND HAVE ALWAYS BEEN A PEOPLE IN OUR OWN RIGHT.

HE'D FOUND HIMSELF A NEW KIND OF ACTIVISM...

...ZIONISM.

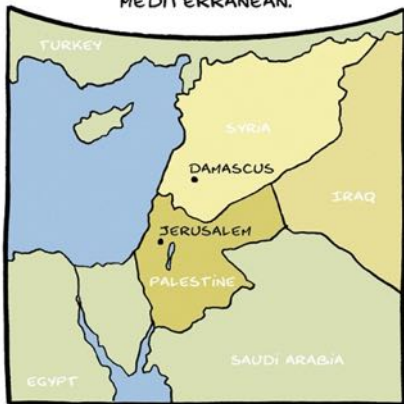


IS THAT ANOTHER SCIENTIFIC THEORY?

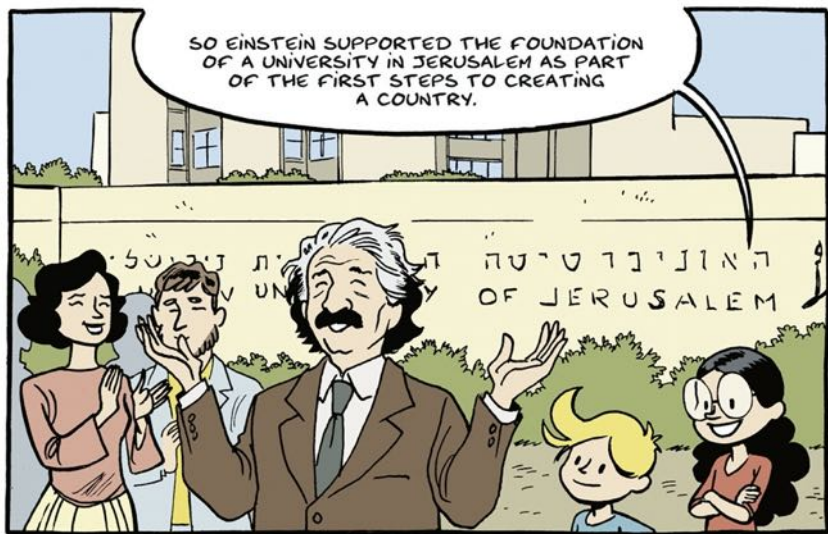
NO, NO, IT WAS A POLITICAL MOVEMENT THAT WANTED JEWISH PEOPLE TO HAVE THEIR OWN COUNTRY...

...FOR THE FIRST TIME.

IN FACT, THE BRITISH HAD PROMISED BACK IN 1917 TO HELP CREATE ONE FOR THEM IN PALESTINE, IN THE EASTERN MEDITERRANEAN.



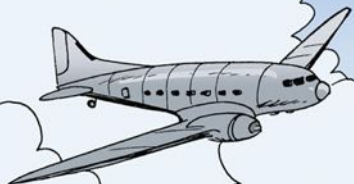
SO EINSTEIN SUPPORTED THE FOUNDATION OF A UNIVERSITY IN JERUSALEM AS PART OF THE FIRST STEPS TO CREATING A COUNTRY.



THIS DOESN'T HAVE MUCH TO DO WITH RELATIVITY.

NO, BUT IT'S A VERY IMPORTANT PART OF EINSTEIN'S LIFE.

IN 1933, WHEN HITLER CAME TO POWER, ALBERT WAS TRAVELING.



HE DECIDED NOT TO RETURN TO GERMANY, WHERE HIS BOOKS WERE BURNED AND HIS HOUSE LOOTED.

AS A REFUGEE IN AMERICA HE GOT A TEACHING JOB AND TRIED TO HELP JEWISH SCIENTISTS FLEEING GERMANY TO GET INTO THE U.S.

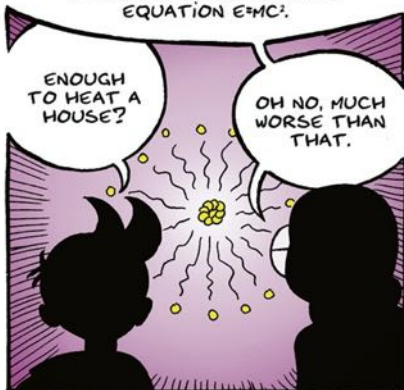


THE RISE OF NAZISM WAS SO DANGEROUS THAT HE ABANDONED HIS PACIFIST IDEALS AND TURNED HIS ATTENTION TO IDEAS THAT WOULD HAVE TERRIBLE CONSEQUENCES.

DURING THE 1930'S, SCIENTISTS HAD MADE DISCOVERIES THAT MADE A NEW KIND OF WEAPON POSSIBLE.



RESEARCHERS HAD DISCOVERED NUCLEAR FISSION--HOW TO "SPLIT" ATOMS AND RELEASE A HUGE AMOUNT OF ENERGY, JUST LIKE EINSTEIN HAD PREDICTED WITH HIS EQUATION $E=MC^2$.



ENOUGH TO HEAT A HOUSE?

OH NO, MUCH WORSE THAN THAT.

EINSTEIN WAS AFRAID THE NAZIS WOULD WORK THIS OUT TOO, SO HE WROTE TO PRESIDENT ROOSEVELT IN 1939, JUST BEFORE THE START OF THE SECOND WORLD WAR.



This new knowledge could also lead to the development of a new type of bomb—an extremely powerful one.



SO ROOSEVELT SET UP
THE "MANHATTAN PROJECT,"
A TOP-SECRET PROGRAM
LED BY SCIENTISTS AND
MILITARY EXPERTS.

THEY WERE
WORKING ON THE
ATOMIC BOMB!

THIS WORRIED
EINSTEIN EVEN MORE,
SO HE WROTE TO
ROOSEVELT AGAIN IN
1945 TO ASK HIM NOT
TO USE IT, BUT THE
PRESIDENT DIED
BEFORE READING
THE LETTER.

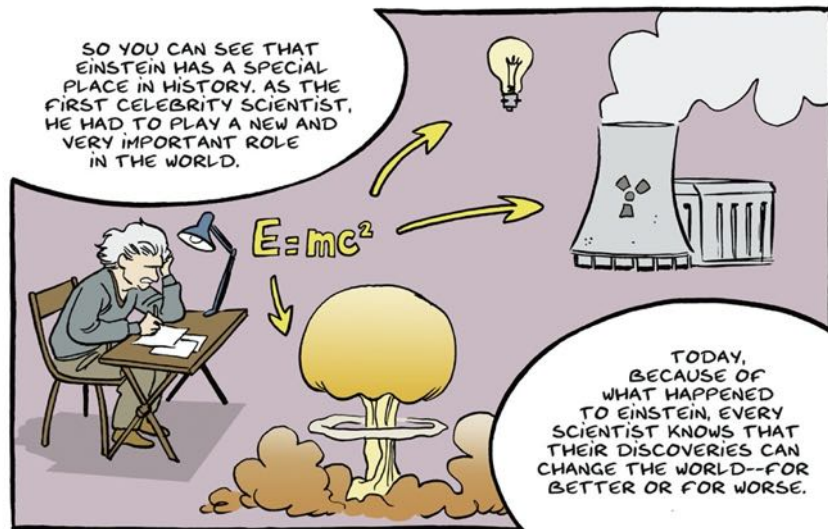
THE NEXT
PRESIDENT
AUTHORIZED
TWO BOMBS TO BE
DROPPED ON JAPAN--ON
HIROSHIMA AND NAGASAKI
(AUGUST 6TH AND 9TH,
1945)--KILLING OVER
100,000 PEOPLE.

IT WAS THE
FIRST TIME IN HISTORY
THAT SO MANY PEOPLE HAD
DIED IN THE SAME PLACE
AT THE SAME TIME.



OVER THE NEXT FEW YEARS, THE U.S. AND THE U.S.S.R. MADE MANY MORE ATOMIC BOMBS. EACH ONE MORE POWERFUL THAN THE LAST, MAKING IT POSSIBLE FOR THE ENTIRE HUMAN RACE TO BE WIPED OUT.





AFTER 1945, EINSTEIN CONTINUED HIS ACTIVISM, BUT MORE BEHIND THE SCENES.



IN 1948, FOR EXAMPLE, A JEWISH NATION, ISRAEL, WAS FINALLY CREATED, BUT A WAR IMMEDIATELY STARTED BETWEEN JEWS AND ARABS.

IT WAS JUST WHAT EINSTEIN HAD FEARED. HE'D PREDICTED IT WAY BACK IN 1923.



OPEN COOPERATION WITH THE ARABS IS NECESSARY FOR PEACE AND PROSPERITY.

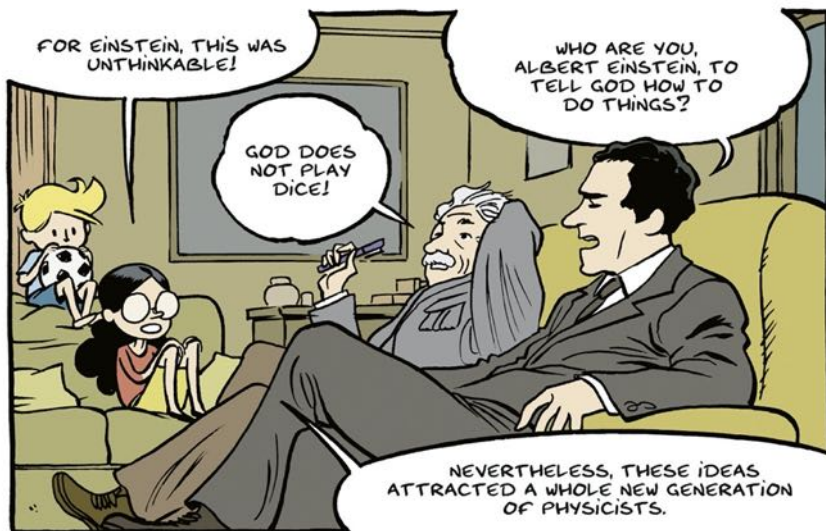
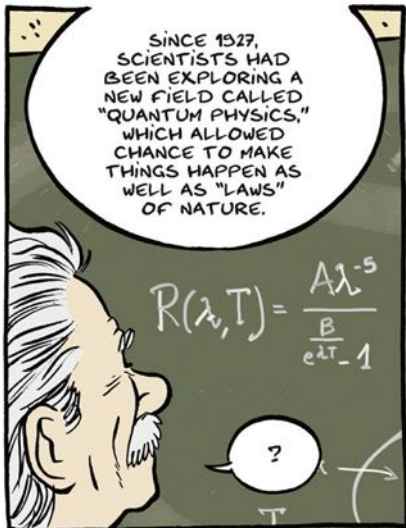
SO, WHEN ISRAEL'S FOUNDERS ASKED HIM TO BE PRESIDENT IN 1952, HE REFUSED.

HIS PRIORITIES WERE PACIFISM AND DEFENDING HUMAN RIGHTS, NOT JUST IN ISRAEL, BUT THROUGHOUT THE WORLD...



...AS WELL AS REMAINING INDEPENDENT!





AT THE END OF HIS LIFE,
EINSTEIN WAS STILL A BIG STAR,
BUT HE JUST WANTED TO
BE LEFT ALONE.

THAT'S WHY HE STUCK
HIS TONGUE OUT WHEN
PHOTOGRAPHERS SURROUNDED
HIM ON HIS WAY HOME FROM
HIS 72ND BIRTHDAY
PARTY!



HE DIED AT
THE AGE OF
76 IN 1955.

NEW YORK WORLD-TELE
DR EINSTEIN IS DEAD AT 76

IT WAS
HEADLINE
NEWS.



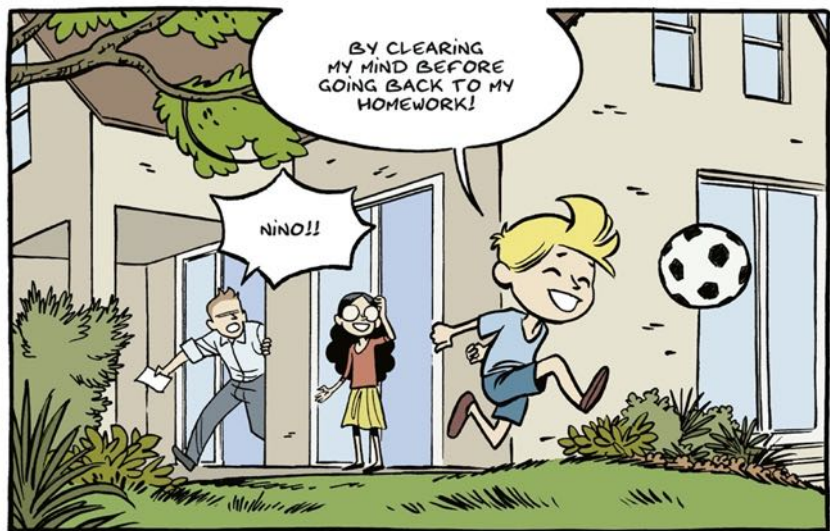
EVEN AFTER HIS DEATH HE
WENT ON BEING TALKED ABOUT!
THE DOCTOR WHO WROTE THE
DEATH CERTIFICATE REMOVED
HIS BRAIN FOR RESEARCH!

YUCK!
AND WHAT
DID HE
DISCOVER?



NOT A LOT, YOU
SEE, INTELLIGENCE IS
MORE ABOUT HOW YOU
USE YOUR BRAIN THAN
ABOUT WHAT SHAPE
IT IS OR HOW BIG
IT IS.





And there's more...



Four other scientists who made history



Max Planck

(1858-1947)

A German physicist who came up with the idea of particles (quanta), which Einstein later developed and which eventually led to quantum physics. It was Planck's observations that gave Einstein his ideas about light. Planck won the Nobel Prize in 1918 and was an early supporter of Einstein's theories. In 1929, he and Einstein won the very first Max Planck medals!



Michele Besso

(1873-1955)

A Swiss physicist who first met Einstein when they were both at the Polytechnic Institute in Zurich and remained a close friend. Einstein's theories of relativity developed out of his long discussions with Besso, who was the only other person acknowledged in Einstein's 1905 articles. Besso also helped Albert and Mileva when they divorced, especially by looking after their children. He died in the same year as Einstein.



Karl Schwarzschild

(1873-1916)

A German astrophysicist who was fighting on the Western Front when he read Einstein's paper on general relativity in November 1915. He immediately started making complicated calculations to work out how space-time curved around a star and demonstrated that there were black holes in space. He sent his findings to Einstein, who presented them on Schwarzschild's behalf to the Prussian Academy of Sciences.



Robert Oppenheimer

(1904-1967)

An American physicist who was made scientific head of the Manhattan Project's weapons laboratory and worked on the atomic bomb. After the Second World War, he argued for the peaceful use of nuclear energy and was put under surveillance by the U.S. government. He then went back into research and served as Director of Princeton's Institute for Advanced Study, after Einstein.

Was Mileva Marić overshadowed by Einstein?

How much credit should **Einstein's first wife** take for the development of his theories?

Einstein met Mileva Marić in 1896 at the Polytechnic Institute in Zurich. At that time, it was very rare for women to have access to higher education. Mileva's father had to get special permission for her to take courses normally reserved for men. She proved herself **highly gifted at both physics and math**, but became pregnant in 1900 and was unable to finish her studies, which made it difficult for her to pursue a career as a scientist.



Mileva and Albert married in 1903. They had three children together and for many years they lived as both **professional colleagues** and husband and wife, sharing ideas and discussing the theory of relativity. In a letter to Mileva, Albert even referred to it as “our theory.”

But Mileva was restricted by convention, which expected her to be a housewife, and was never able to pursue a career as a researcher. Only Albert's name appeared on the articles that were published.

The marriage ended in divorce in 1919 and their relationship became strained. Albert distanced himself from her and even from their children, and **he would never acknowledge the part she claimed to have played** during their years of study and research.

So what was Mileva's contribution to Einstein's discoveries? **The question is still hotly debated.**

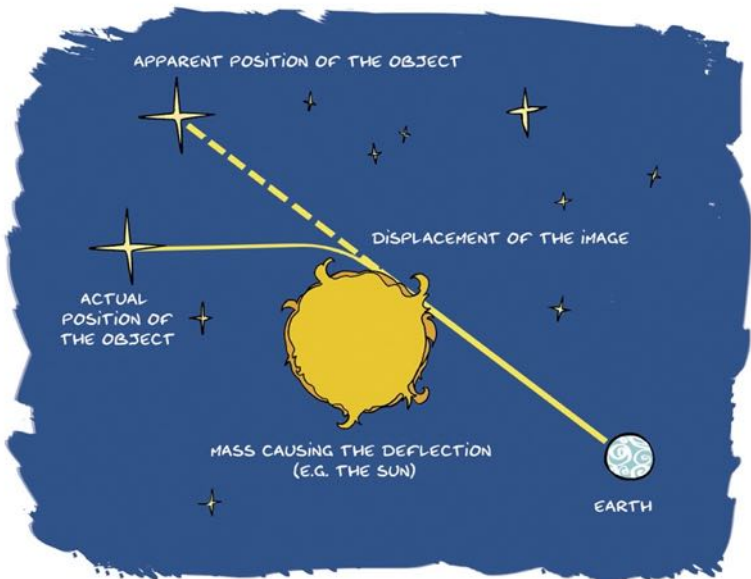
For some, the fact that Albert continued to publish articles after their separation, while Mileva did not, proves that she was not involved in the development of the theories of relativity. For others, Mileva simply suffered the fate of many women at that time—to be forced to live and work in the shadow of men, without ever being given due recognition.



Einstein and astronomy

Eddington's observations

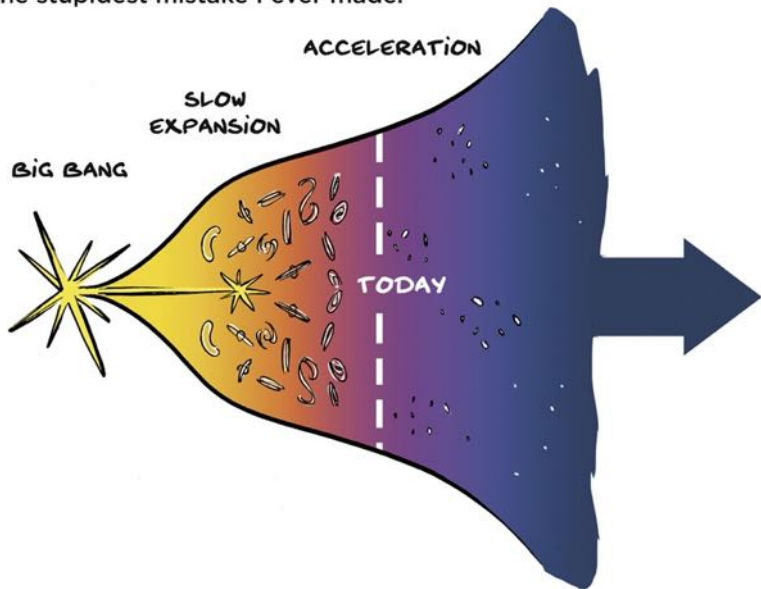
In May 1919, the English astrophysicist Arthur Eddington sailed to the islands of São Tomé and Príncipe, off the coast of Africa, to observe an eclipse of the sun. When the sun disappeared behind the moon, he saw that stars near to the sun appeared to be out of position relative to the Earth. **The light the stars emitted was deflected by the mass of the sun.** It proved that Einstein was right: space-time curved around a large mass.



This phenomenon has been observed many times since. It is called "gravitational lensing" and it means that stars are not always where you think they are!

Hubble's discovery

In 1929, the American astrophysicist Edwin Hubble argued that the universe is expanding—the **galaxies are getting further and further apart**. Einstein rejected this idea. He was convinced the universe was constant. Yet his own theories showed that it was expanding. So he tried to come up with formulas that would prove the theory wrong. He couldn't. Eventually, Einstein accepted the idea, and admitted that rejecting it had been “the stupidest mistake I ever made.”



Hubble's discovery eventually led to the **Big Bang** theory, according to which the universe started expanding 13.7 billion years ago.

What use are Einstein's theories?

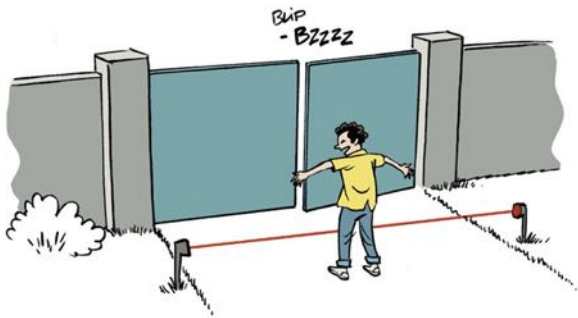
They tell you where you are

GPS satellites that send the signals to our cars so we know where we are travel very fast through space as they orbit the Earth—which means that time passes more slowly for a satellite than it does for us, as Einstein predicted. So their built-in clocks have to be constantly adjusted for them to give us the right information.



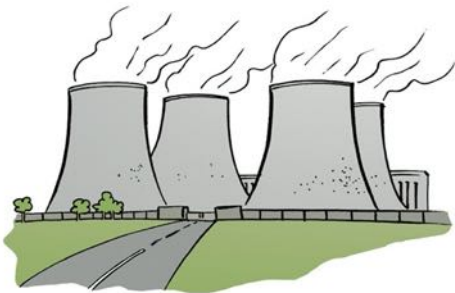
They make electric gates work

The “photoelectric effect” discovered by Einstein in 1905, which won him the 1921 Nobel Prize, means that light can generate an electric current. When we break the beam of light emitted by a gate, it opens automatically.



They generate electricity

Nuclear power stations work according to Einstein's famous formula, $E=mc^2$. When uranium is "burned," it releases a huge amount of heat, which can be used to generate electricity. But the process must be carefully controlled, or it could be disastrous!



They help you to earn money (sometimes)

Decisions on how to invest in the stock market are based on Einstein's theory of "Brownian motion." But the laws of economics are not quite as precise as the laws of physics, which means that things don't always work out as they should. That's why there was a financial crash in 2008!



Timeline

Born in
Ulm (Germany)
on March 14th.

1879

Admitted to the
Polytechnic Institute
in Zurich (Switzerland).

1896

1933

Leaves Germany for
good when Hitler comes
to power.

1928

Becomes President
of the International
League for the
Rights of Man.

1939

Writes to Franklin D. Roosevelt
warning him of the danger of
nuclear fission.

1948

Publishes his book
The World as I See It.

"Annus mirabilis":
publishes a series of
groundbreaking articles
that form the basis of the
Theory of Special Relativity.

1905

Finalizes the
Theory of General
Relativity.

1915

1925

Co-founds the Hebrew
University of Jerusalem
with, among others,
Sigmund Freud.

1921

Receives the Nobel
Prize in Physics.

1952

Refuses appointment
as President of the
State of Israel.

1955

Dies in Princeton
on April 18th.

Fabrice Erre has a Ph.D. in History and teaches Geography and History at the Lycée Jean Jaurès near Montpellier, France. He has written a thesis on the satirical press, writes the blog *Une année au lycée* on the website of *Le Monde*, and has published several comics.

Sylvain Savoia draws the *Marzi* series, which tells the history of Poland as seen through the eyes of a child. He has also drawn *Les esclaves oubliés de Tromelin*, which won the Académie de Marine de Paris prize.

Collection edited by
Frédéric Niffle and Lewis Trondheim

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