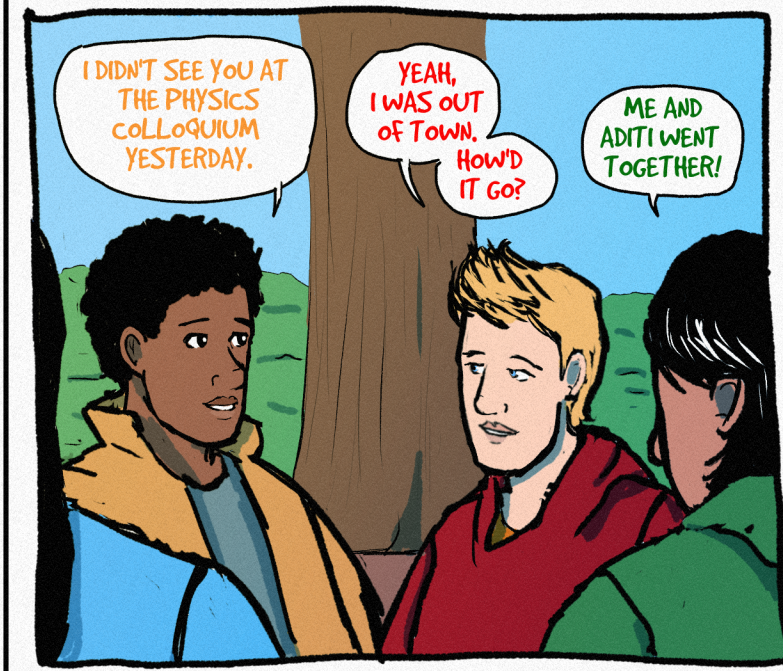
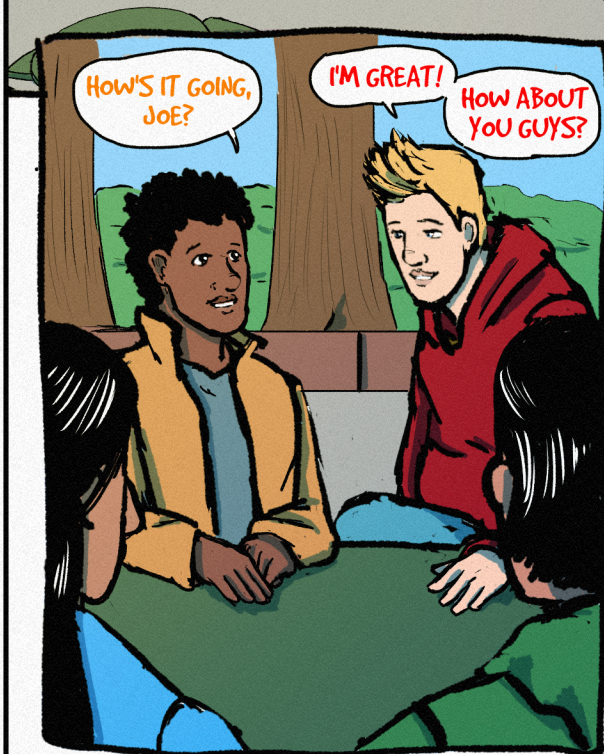
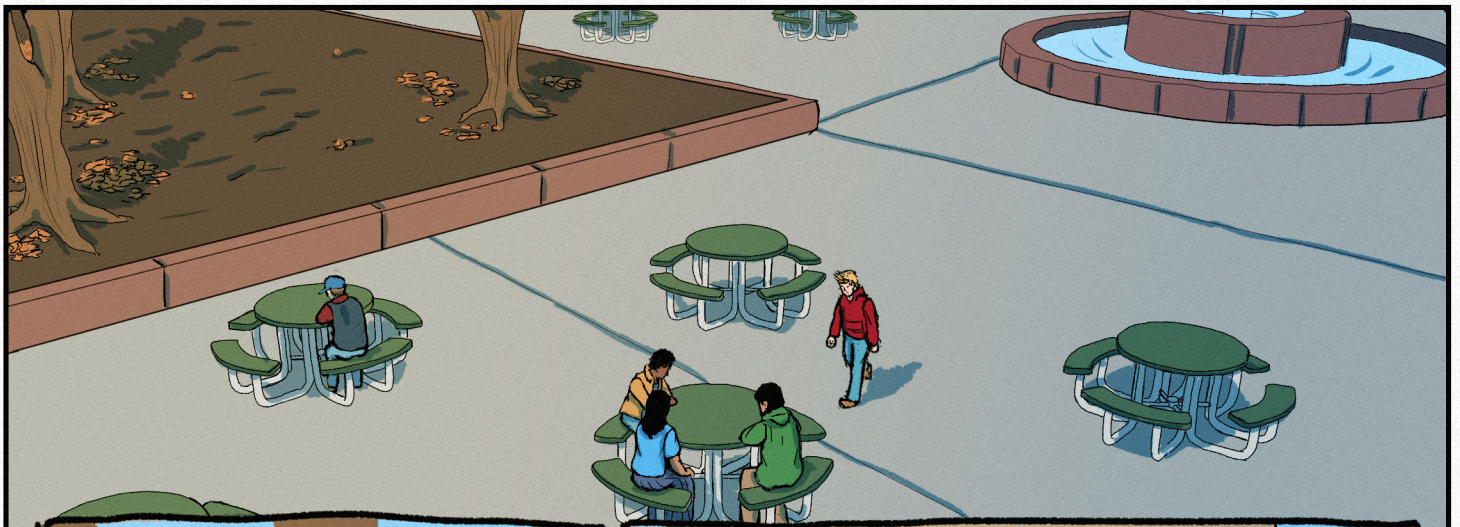


METAMATERIALS



BENDING REALITY

Written by Pragati Karki Drawn by Jessica Bolden



I JUST WANTED
TO KEEP JESSI
COMPANY.

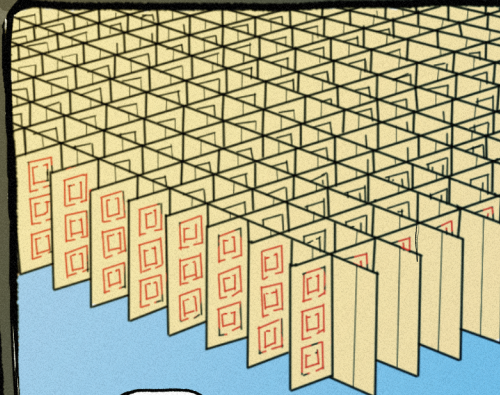
BUT I DID
LEARN A LOT
ABOUT
METAMATERIALS!

WHAT IS A
METAMATERIAL?

METAMATERIALS ARE SYNTHETIC
COMPOSITE MATERIALS MADE
FROM ORDINARY MATERIALS.
THEY ARE PUT TOGETHER AND
CONFIGURED IN A WAY THAT
ALLOWS UNIQUE MANIPULATION
OF LIGHT OR ACOUSTIC WAVES.

WHAT DO YOU
MEAN?

FOR EXAMPLE,
THIS METAMATERIAL
HAS A NEGATIVE INDEX
OF REFRACTION, WHICH
MEANS IT CAN BEND LIGHT
BACKWARDS.

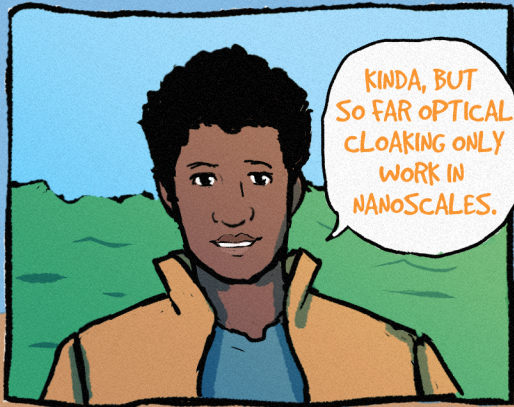


WOAH!

WHAT ELSE CAN
METAMATERIALS
DO?

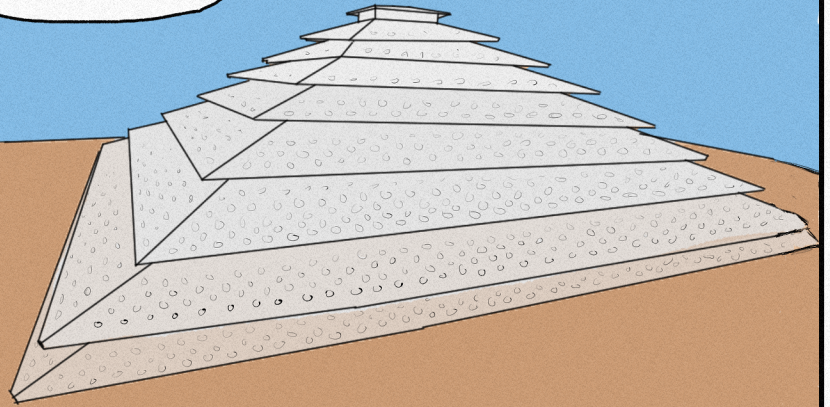
THERE ARE
METAMATERIALS
THAT CAN ACT AS
INVISIBILITY
CLOAKS!

AN INVISIBILITY CLOAK?
LIKE HARRY POTTER?

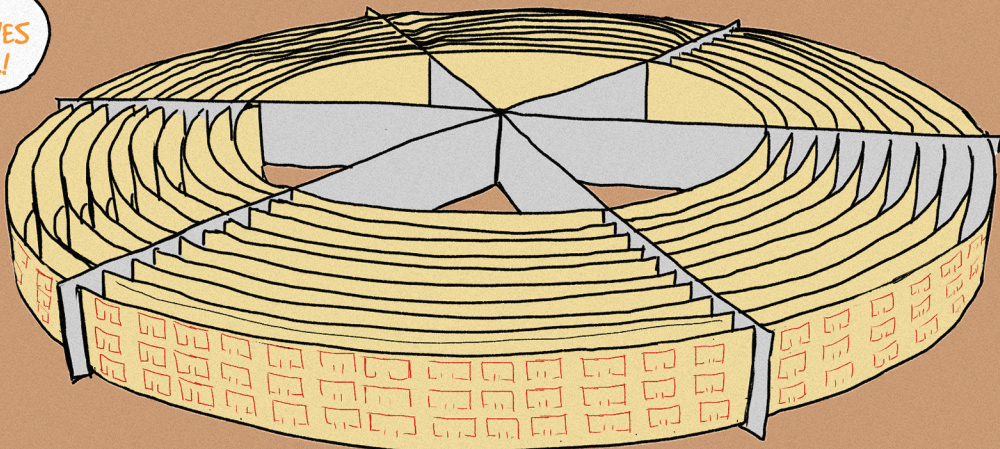


KINDA, BUT
SO FAR OPTICAL
CLOAKING ONLY
WORK IN
NANOSCALES.

THERE ARE LARGER
INVISIBILITY CLOAKS
FOR ACOUSTIC WAVES.

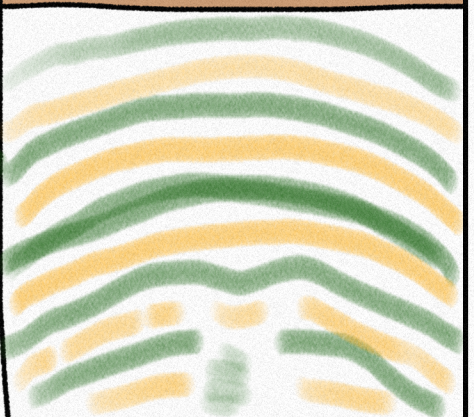
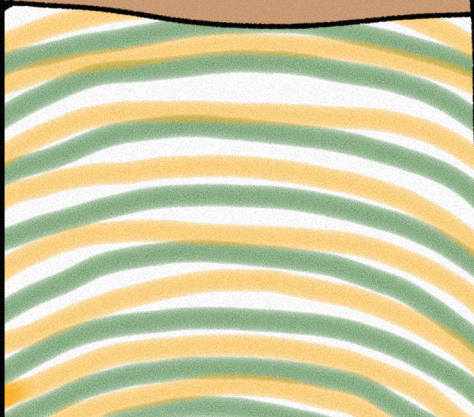
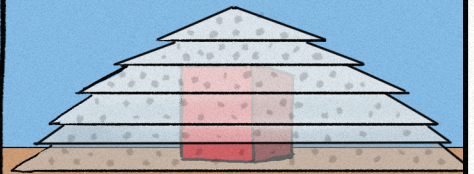
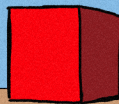


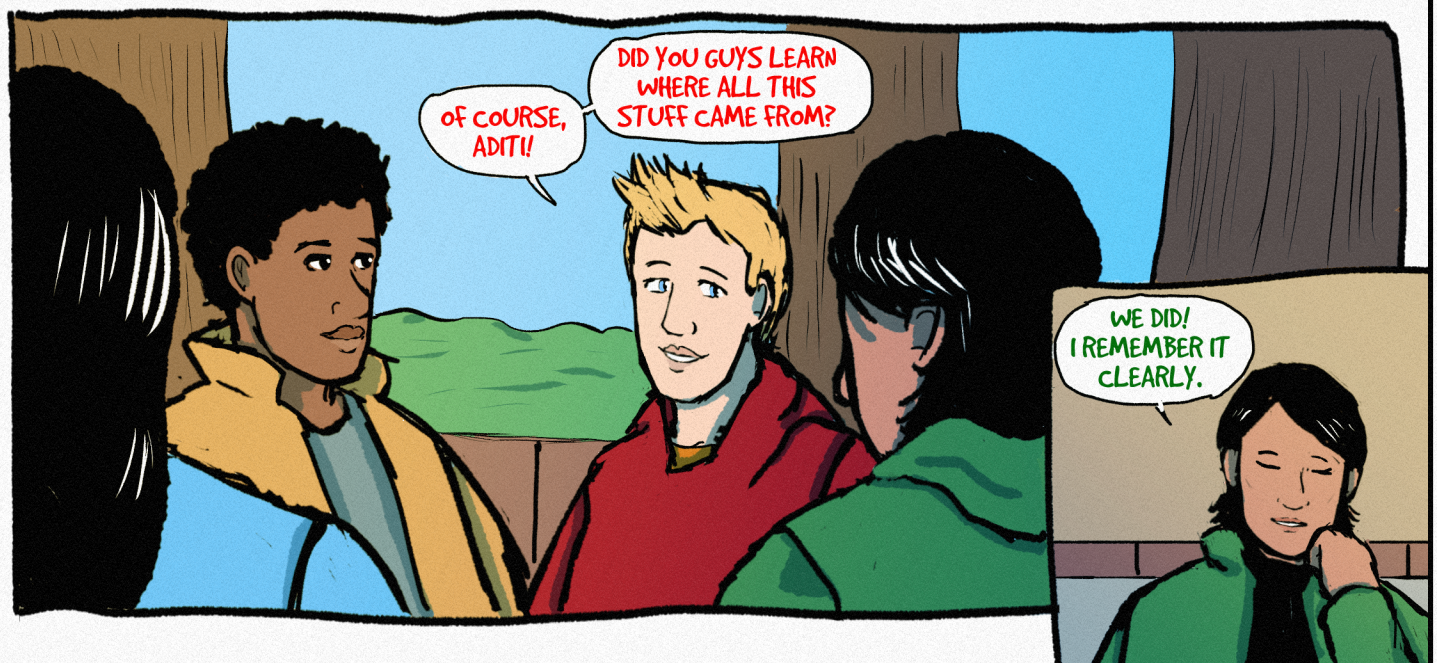
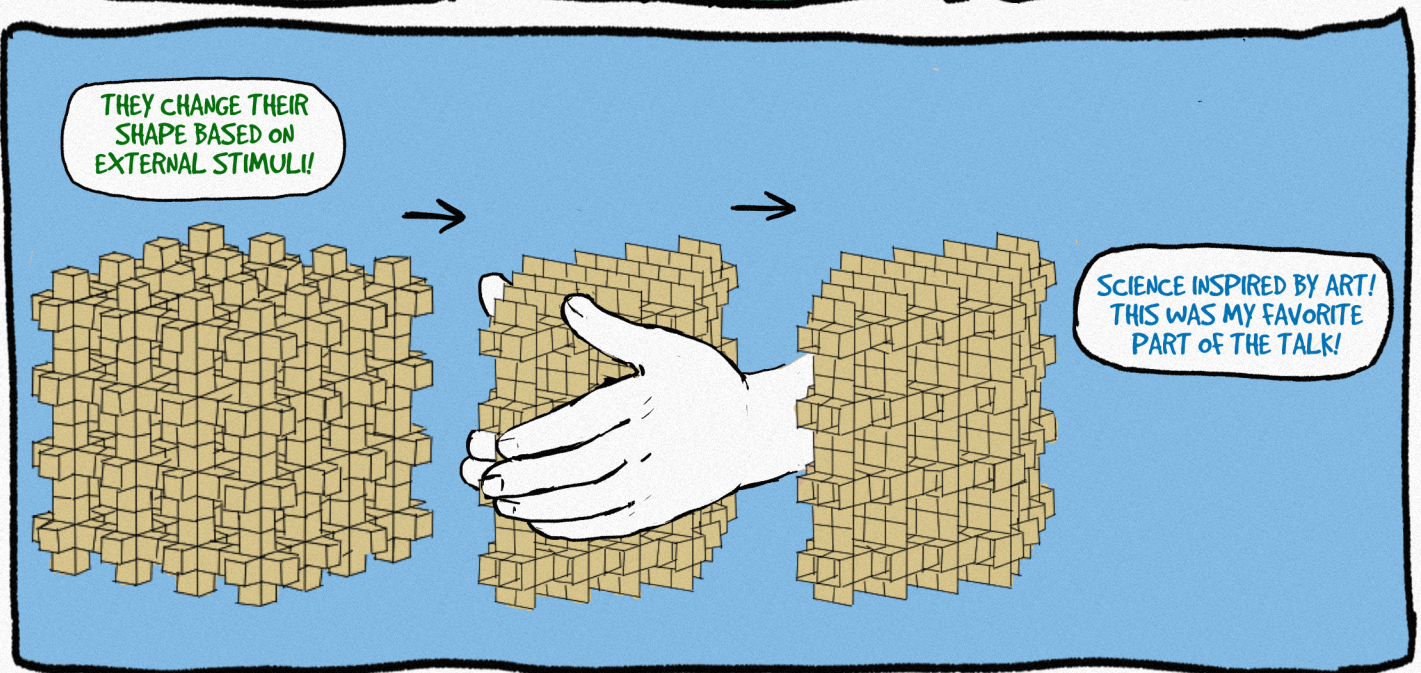
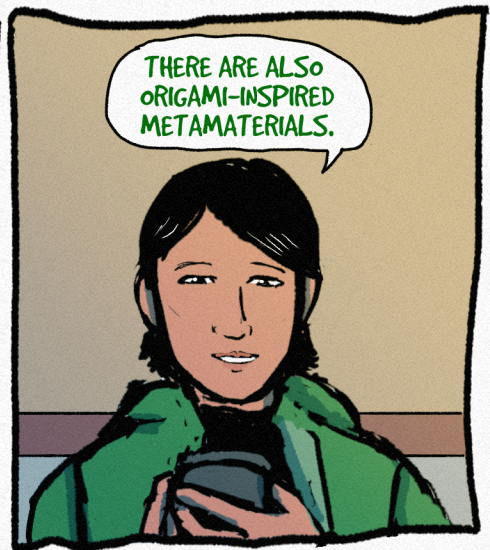
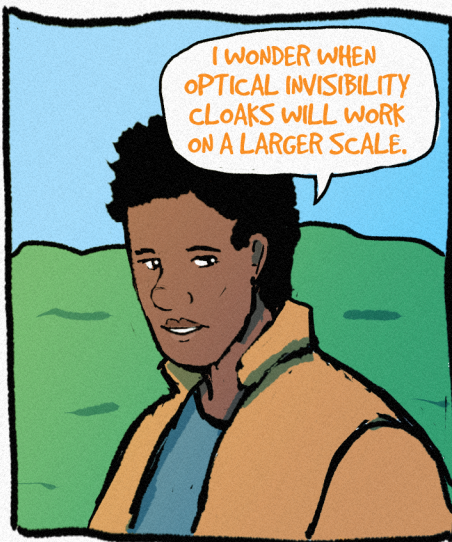
AND FOR
MICROWAVES
AS WELL!



CLOAKING LOOKS
KINDA LIKE THIS.

ACOUSTIC SONAR EXPERIMENT





RODGER M. WALSER



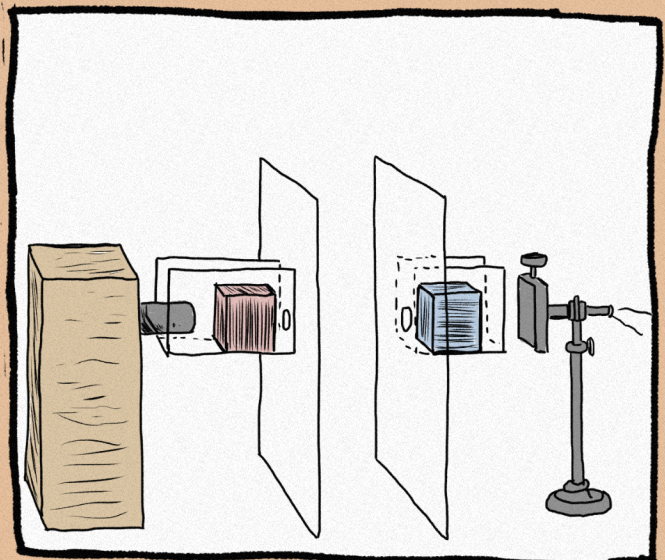
1999 - COINED THE TERM
METAMATERIAL.

EXTENSIVELY DEVELOPED THE
EARLY CONCEPTS
OF METAMATERIALS.

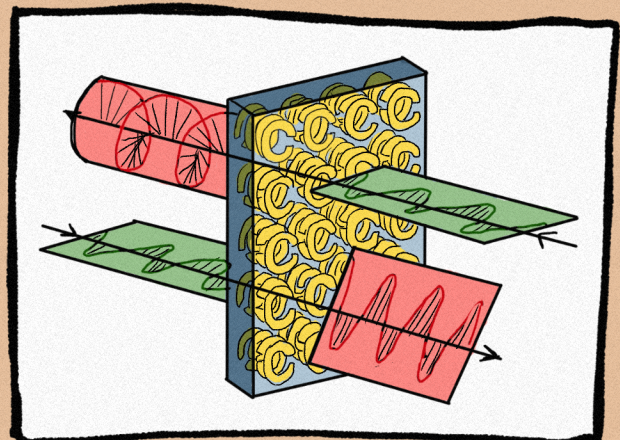
JAGADISH CHANDRA BOSE



1898 - PERFORMED EARLY
EXPERIMENTS ON
WHAT WE CALL
METAMATERIALS TODAY.



POLARIZED
ELECTROMAGNETIC WAVES
USING TWISTED STRUCTURES.



MODERN VERSION

DAVID R. SMITH

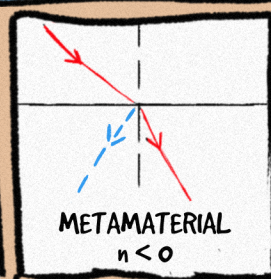
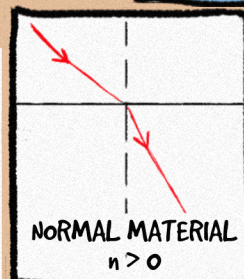
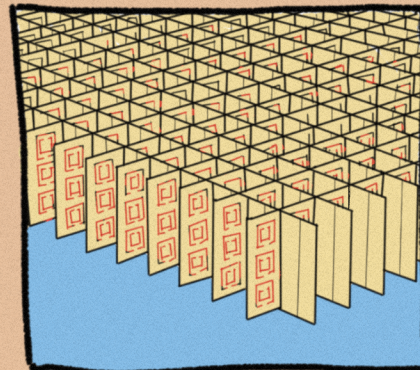


2000-
INVENTED
METAMATERIAL
WITH NEGATIVE
REFRACTIVE INDEX

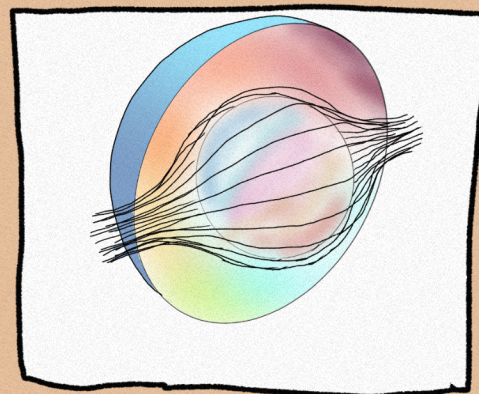
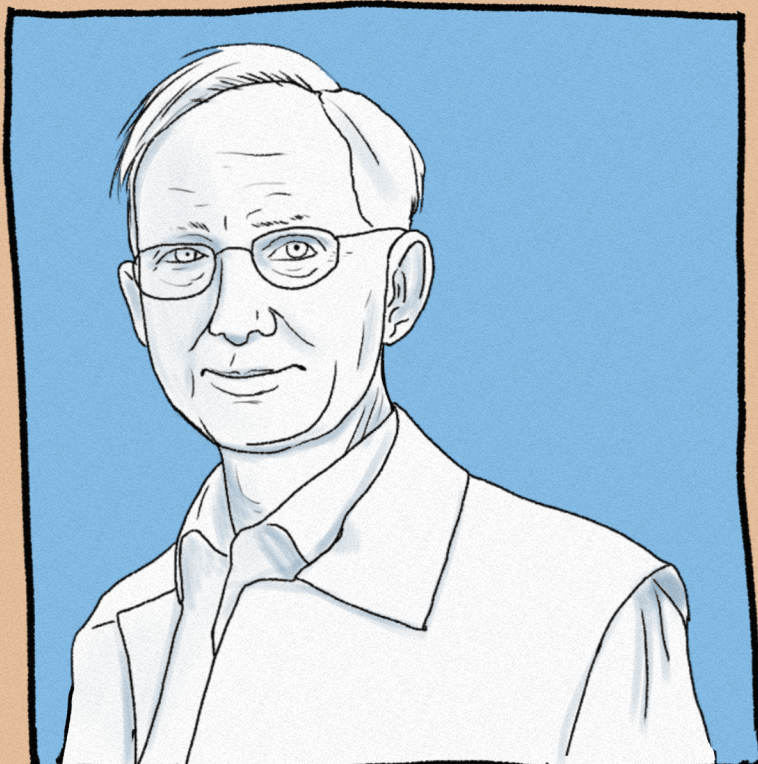
THE INDEX OF
REFRACTION,
$$n = \sqrt{\epsilon\mu}$$

 ϵ = PERMITTIVITY
 μ = PERMEABILITY

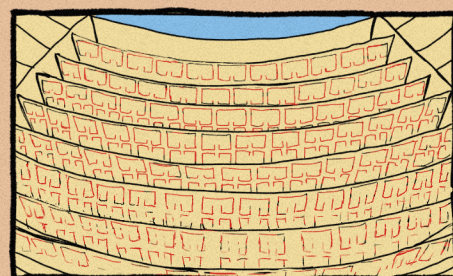
$n < 0$ CREATES
BIZARRE
CONSEQUENCES



SIR JOHN B. PENDRY



PIONEER IN THE FIELD OF
METAMATERIALS WITH
EARLY THEORIES AND
DESIGN.

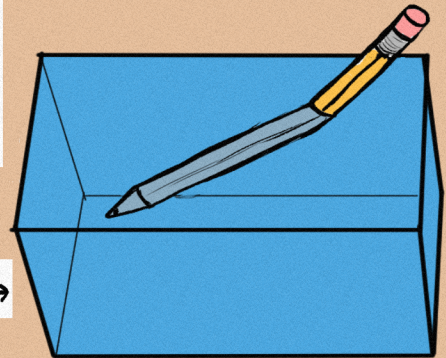


VICTOR VESELAGO



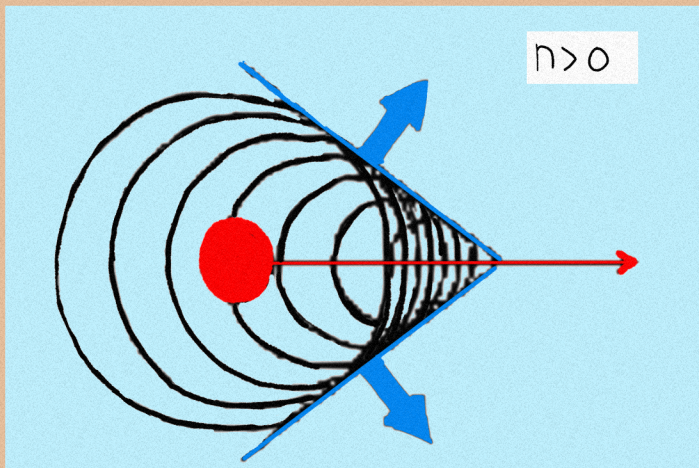
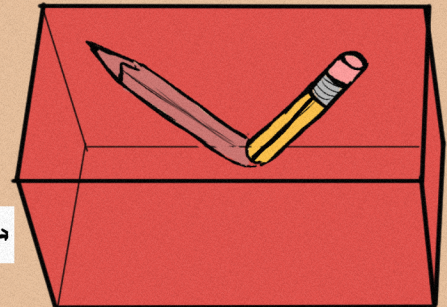
1967- PREDICTED
NEGATIVE
REFRACTIVE INDEX

$n > 0 \rightarrow$

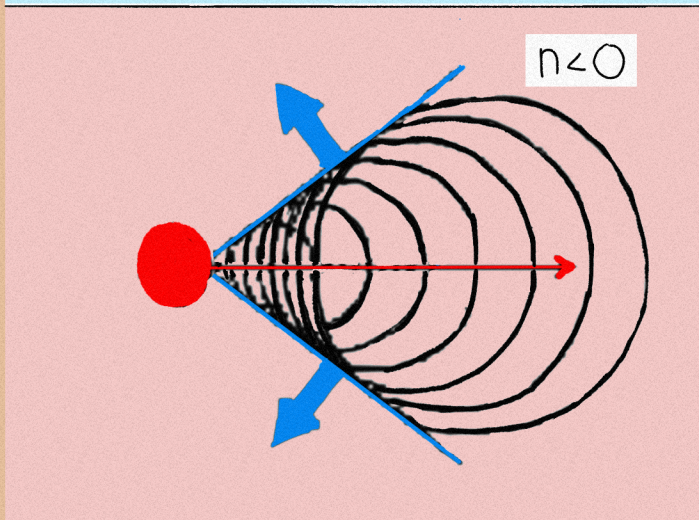


CREATES UNUSUAL
BENDING OF LIGHT.

$n < 0 \rightarrow$



CHARGED OBJECTS TRAVELING
FASTER THAN THE SPEED OF
LIGHT IN A MEDIUM CREATES
CHERENKOV RADIATION IN THE
DIRECTION OF TRAVEL.



IN A MEDIUM WITH A NEGATIVE
REFRACTIVE INDEX,
THE DIRECTION OF CHERENKOV
RADIATION IS REVERSED.



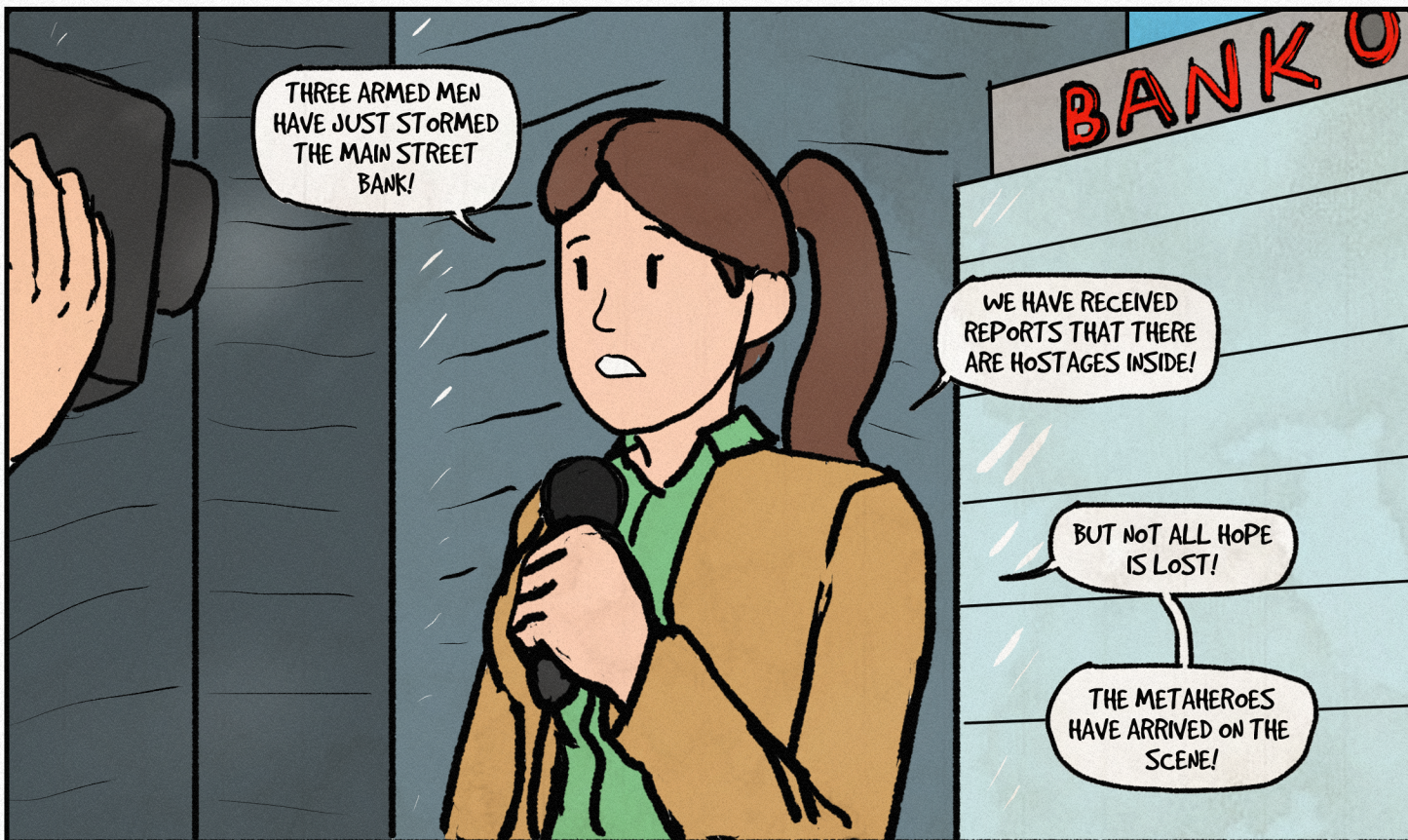
THAT'S
So cool!

WHAT OTHER
APPLICATIONS
ARE THERE?

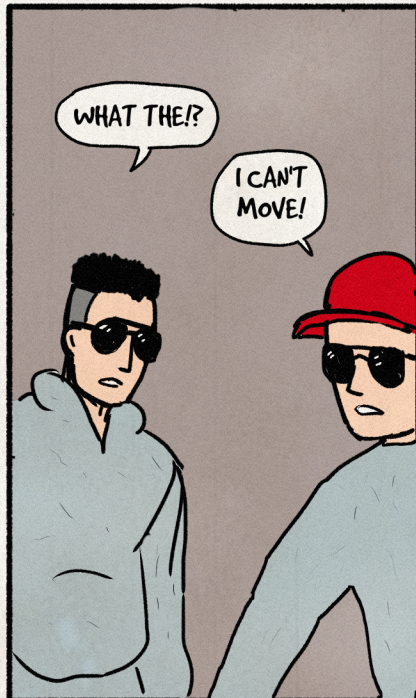
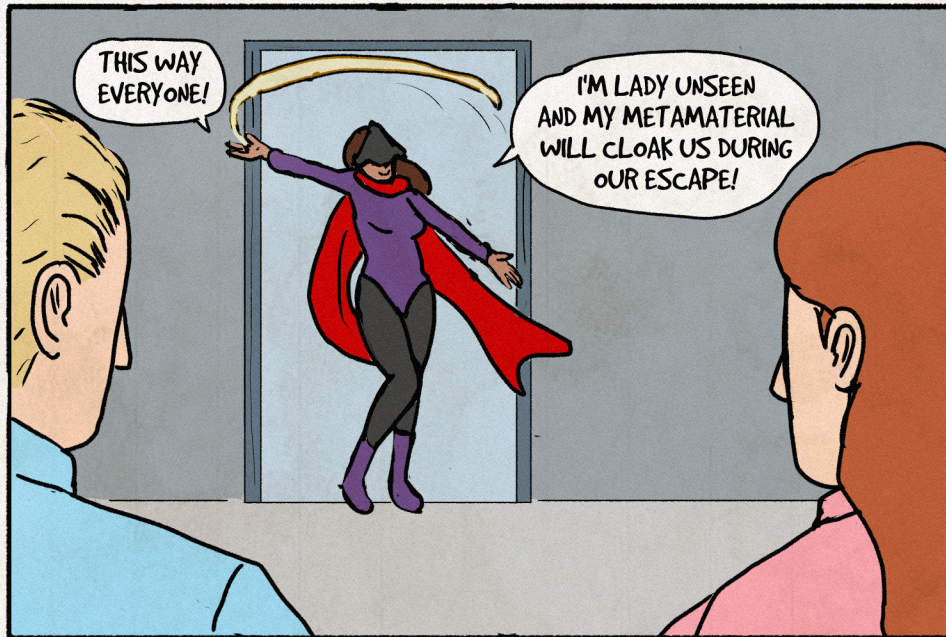
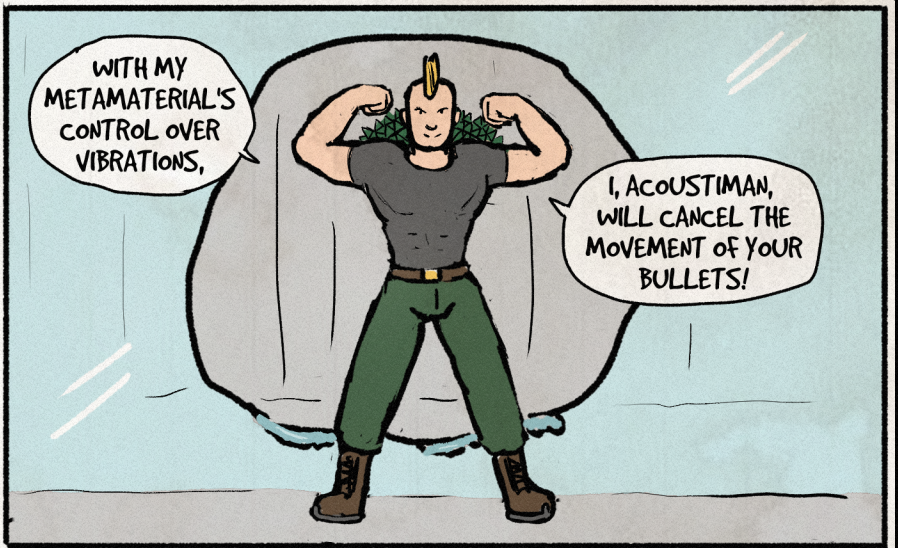
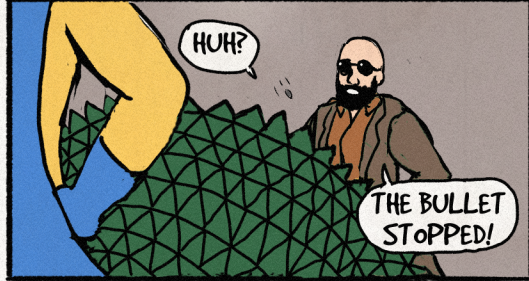
WELL,
THERE'S...

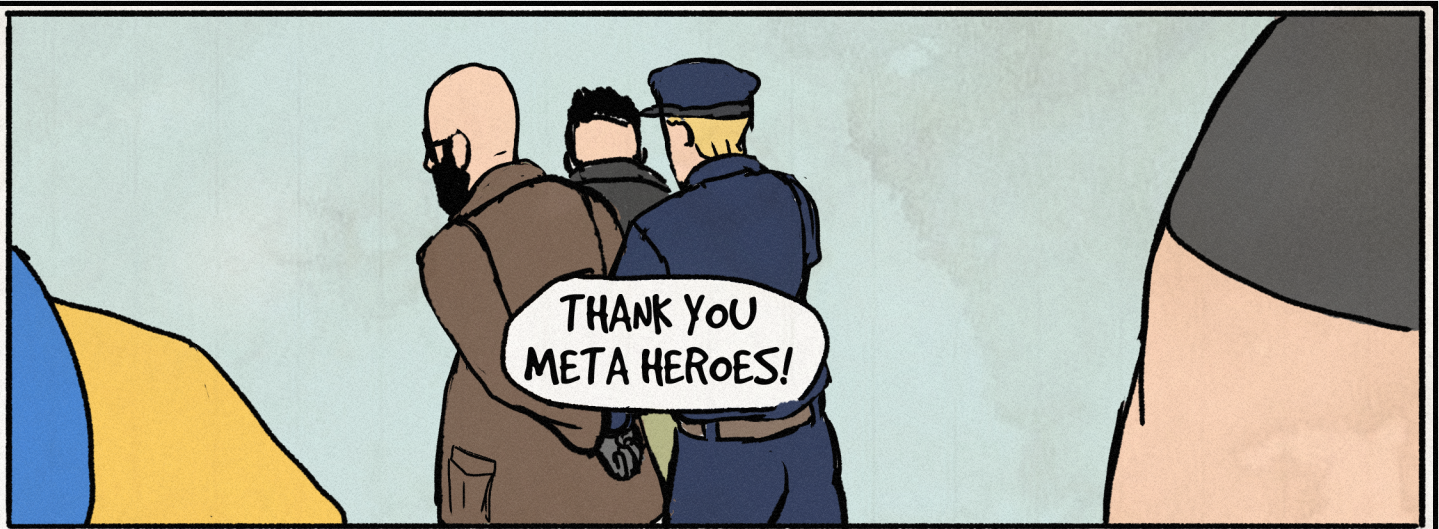
THE METAHEROES









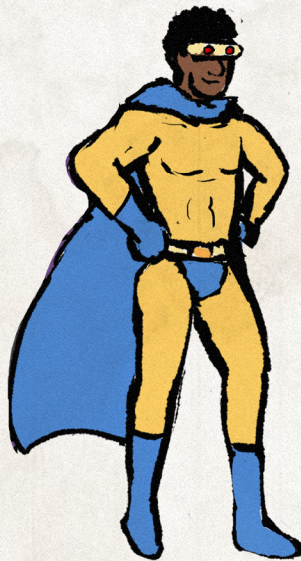


LADY UNSEEN



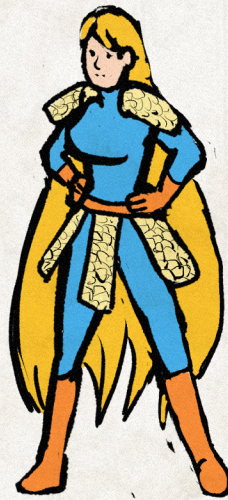
CAN MANIPULATE OPTICAL WAVES AND MAKE HERSELF AND OTHERS INVISIBLE.

SUPERLENSER



CAN REDIRECT LIGHT RAYS AND BEAMS IN HIS DESIRED MANNER.

SHAPESHIFTER



CAN CHANGE THE SHAPE OF OBJECTS AND THEIR PROPERTIES.

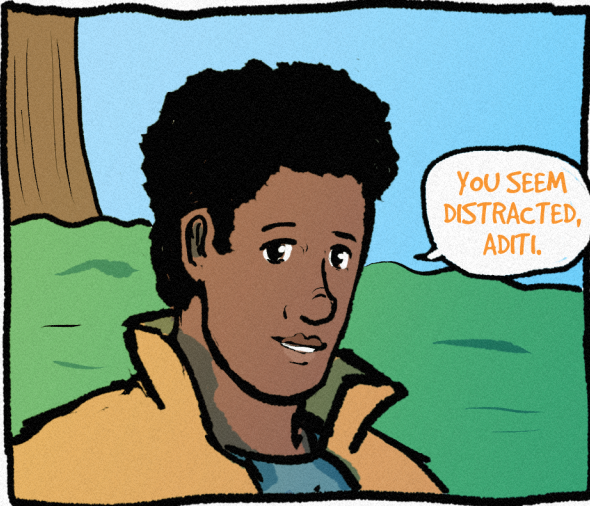
ACOUSTOMAN



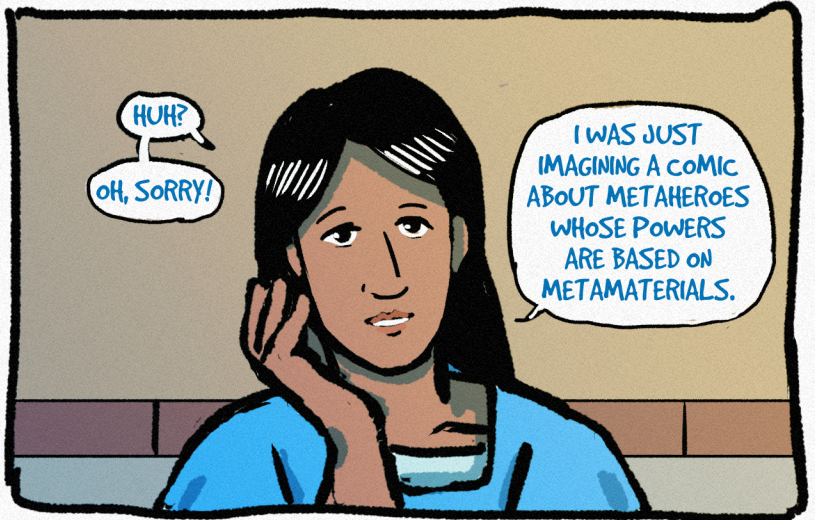
CAN CONTROL SOUND AND ACOUSTIC VIBRATIONS.

o
o



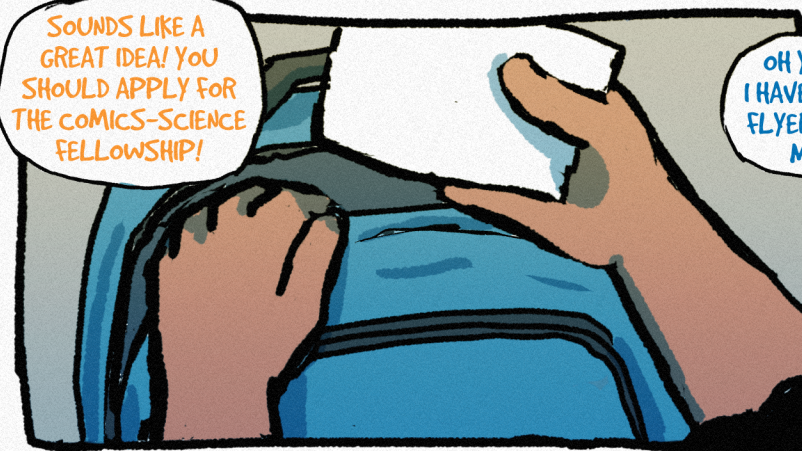


YOU SEEM
DISTRACTED,
ADITI.

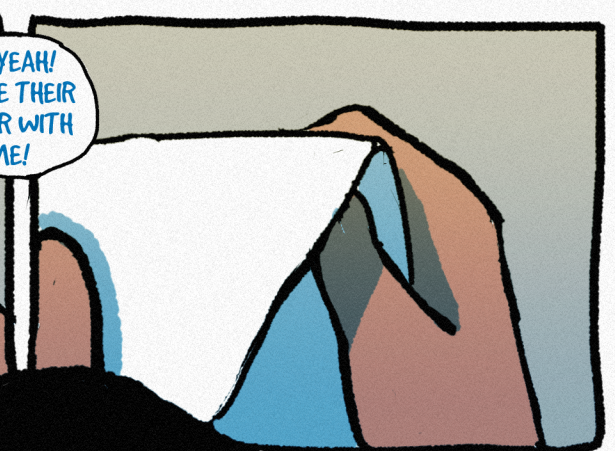


HUH?
OH, SORRY!

I WAS JUST
IMAGINING A COMIC
ABOUT METAHEROES
WHOSE POWERS
ARE BASED ON
METAMATERIALS.



SOUNDS LIKE A
GREAT IDEA! YOU
SHOULD APPLY FOR
THE COMICS-SCIENCE
FELLOWSHIP!



OH YEAH!
I HAVE THEIR
FLYER WITH
ME!

I WAS THINKING
ABOUT APPLYING.



DO YOU GUYS
WANNA HELP?