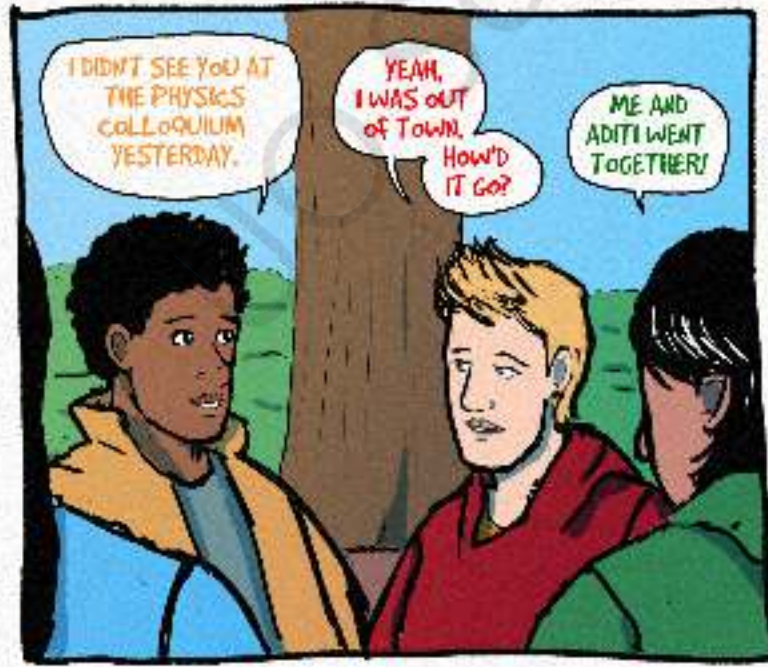


METAMATERIALS



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!



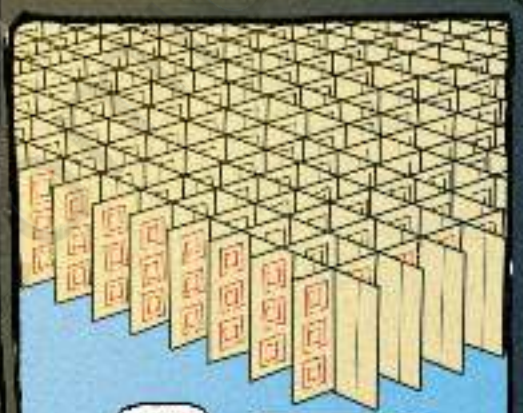
WHAT IS A METAMATERIAL?

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!

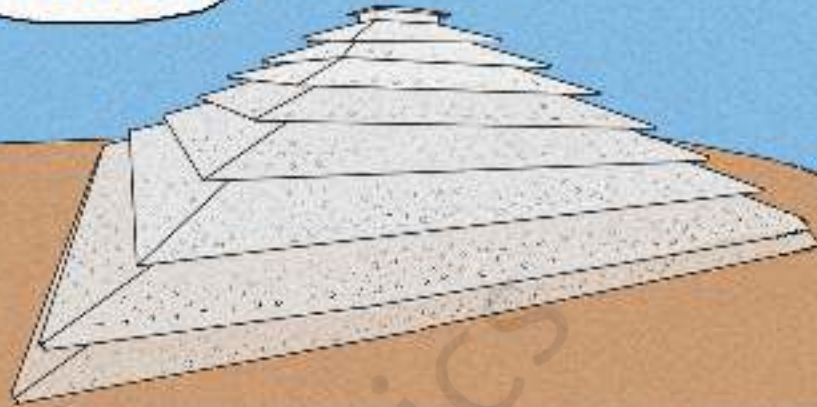
AN INVISIBILITY CLOAK? LIKE HARRY POTTER?



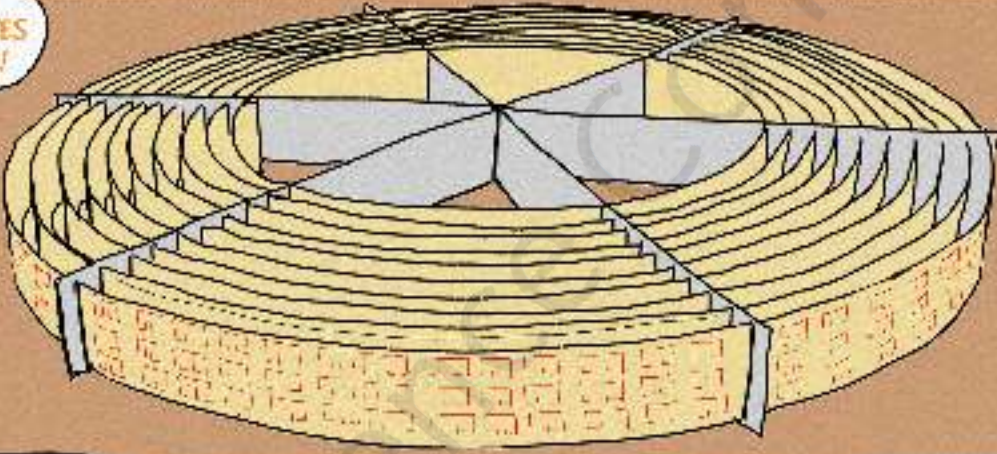


KINDA, BUT SO FAR OPTICAL CLOAKING ONLY WORKS IN NANOSCALES.

THERE ARE LARGER INVISIBILITY CLOAKS FOR ACOUSTIC WAVES.

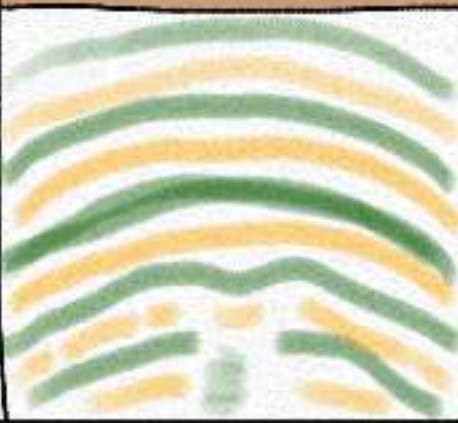
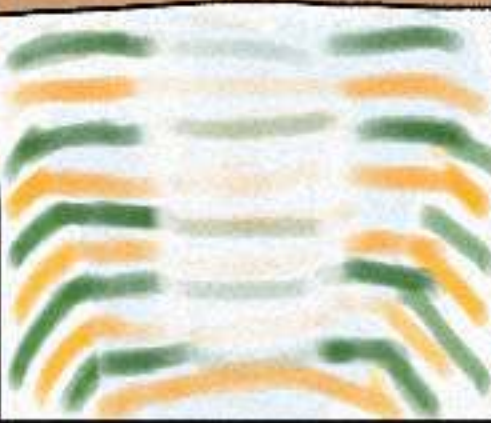


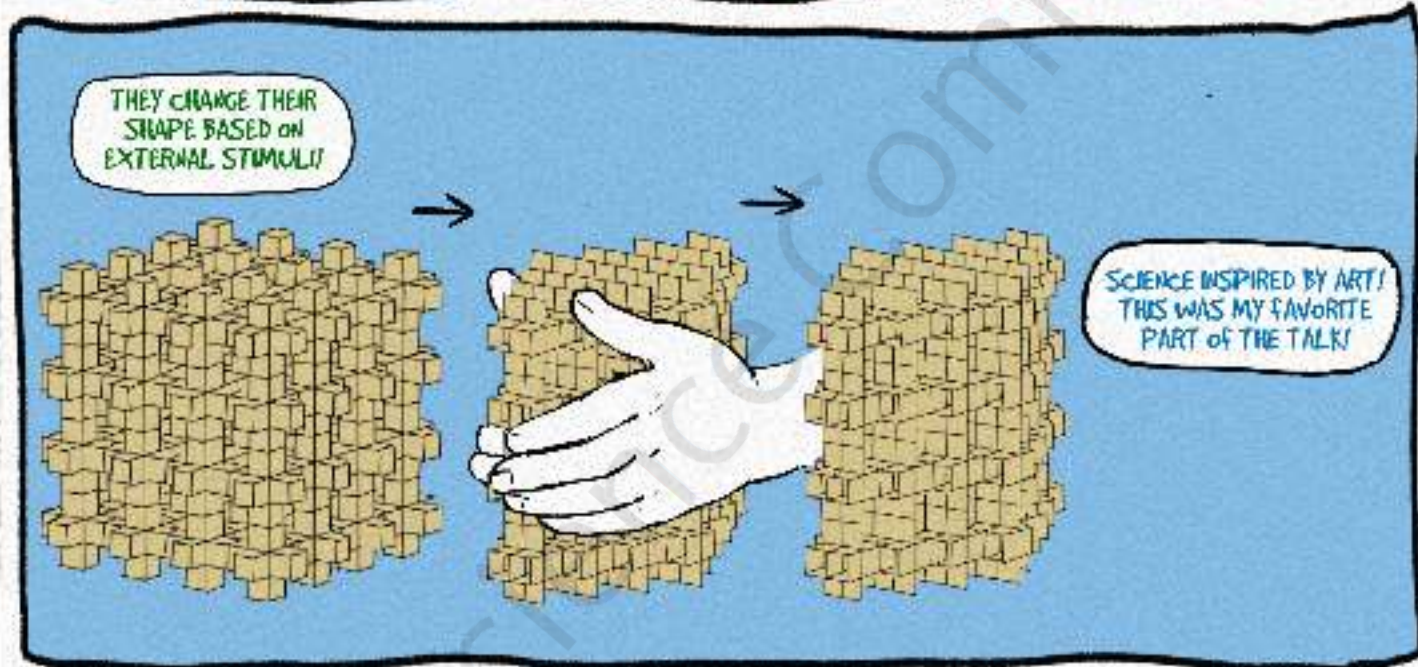
AND FOR MICROWAVES AS WELL!



CLOAKING LOOKS KINDA LIKE THIS.

ACOUSTIC SONAR EXPERIMENT





RODGER M. WALSER



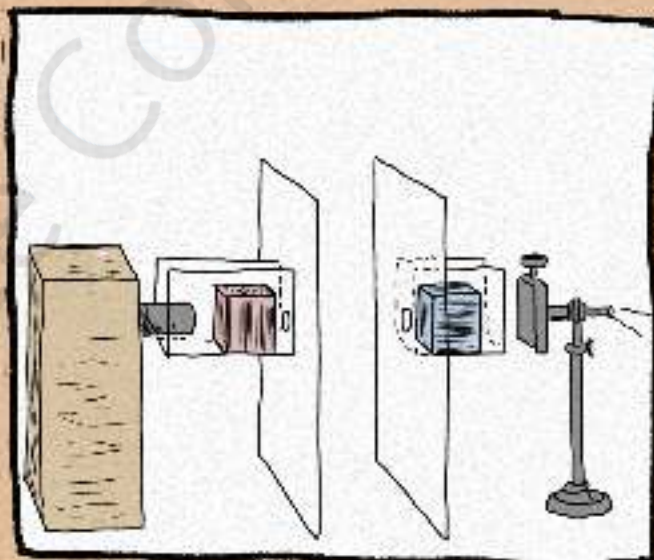
1999 - COINED THE TERM
METAMATERIAL.

EXTENSIVELY DEVELOPED THE
EARLY CONCEPTS
OF METAMATERIALS.

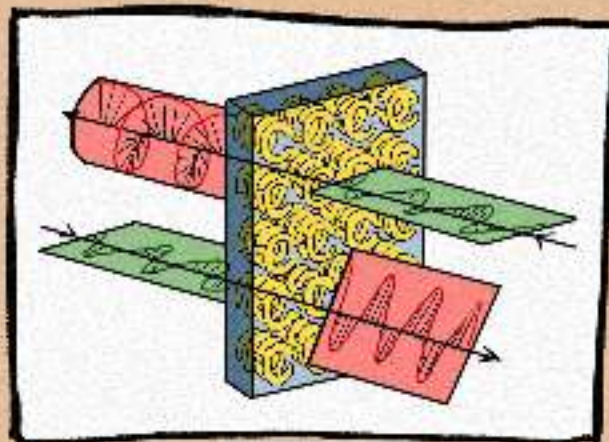
JAGADISH CHANDRA BOSE



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



POLARIZED
ELECTROMAGNETIC WAVES
USING TWISTED STRUCTURES.

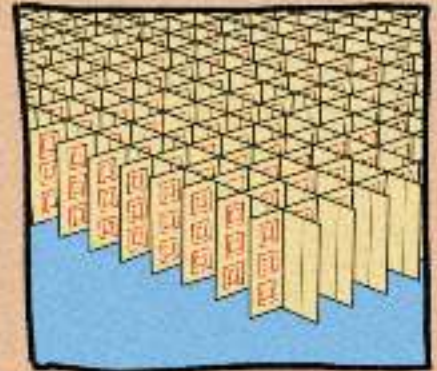


MODERN VERSION

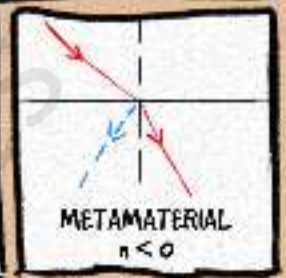
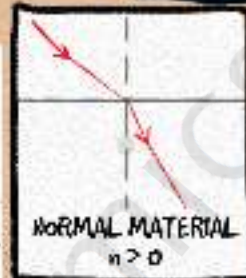
DAVID R. SMITH



2000-
INVENTED
METAMATERIAL
WITH NEGATIVE
REFRACTIVE INDEX



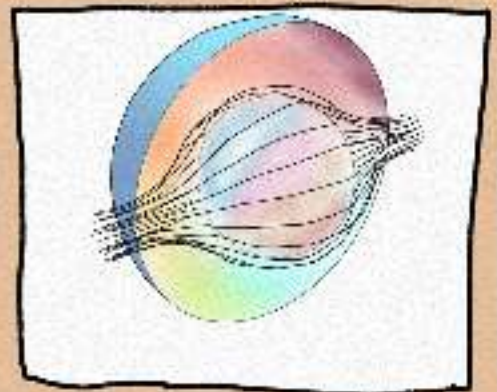
THE INDEX OF
REFRACTION,
 $n = \sqrt{\epsilon\mu}$
 ϵ = PERMITTIVITY
 μ = PERMEABILITY



$n < 0$ CREATES
BIZARRE
CONSEQUENCES



SIR JOHN B. PENDRY



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

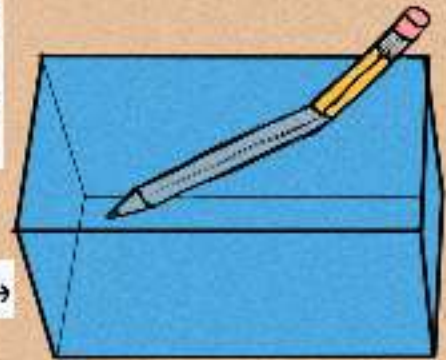


VICTOR VESELAGO



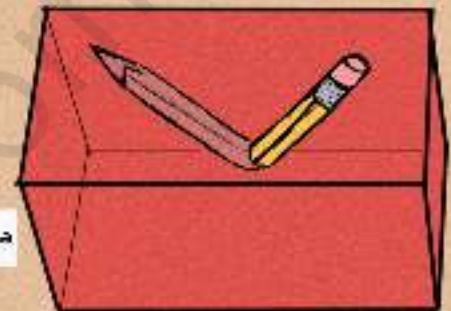
1967- PREDICTED
NEGATIVE
REFRACTIVE INDEX

$$n > 0 \rightarrow$$

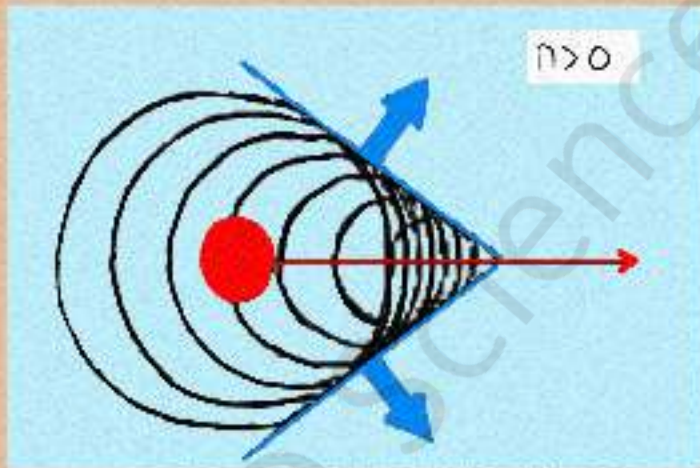


CREATES UNUSUAL
BENDING OF LIGHT.

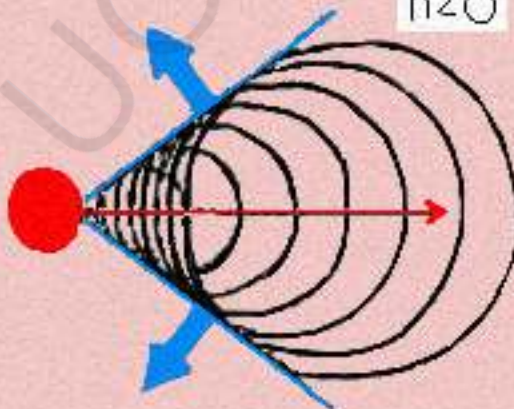
$$n < 0 \rightarrow$$



$$n > 0$$



$$n < 0$$



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.



THE METAHEROES





THREE ARMED MEN
HAVE JUST STORMED
THE MAIN STREET
BANK!

WE HAVE RECEIVED
REPORTS THAT THERE
ARE HOSTAGES INSIDE!

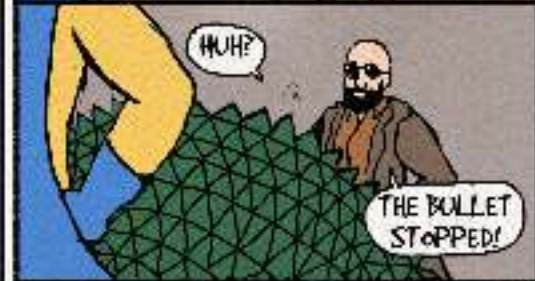
BUT NOT ALL HOPE
IS LOST!

THE METAHEROES
HAVE ARRIVED ON THE
SCENE!



THERE'S SUPERLENSER USING
HIS METAMATERIAL TO
MELT THE WALL TO
SNEAK INSIDE!







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.

ACOUSTAMAN



CAN CONTROL SOUND AND ACOUSTIC VIBRATIONS.





YOU SEEM
DISTRACTED,
ANTI.



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?