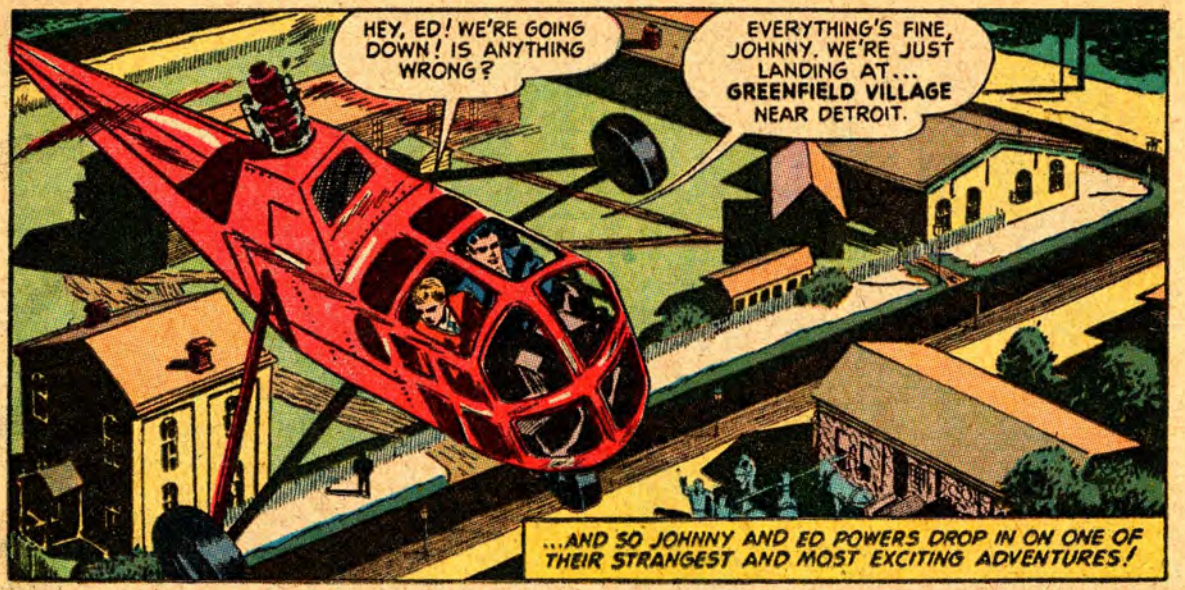
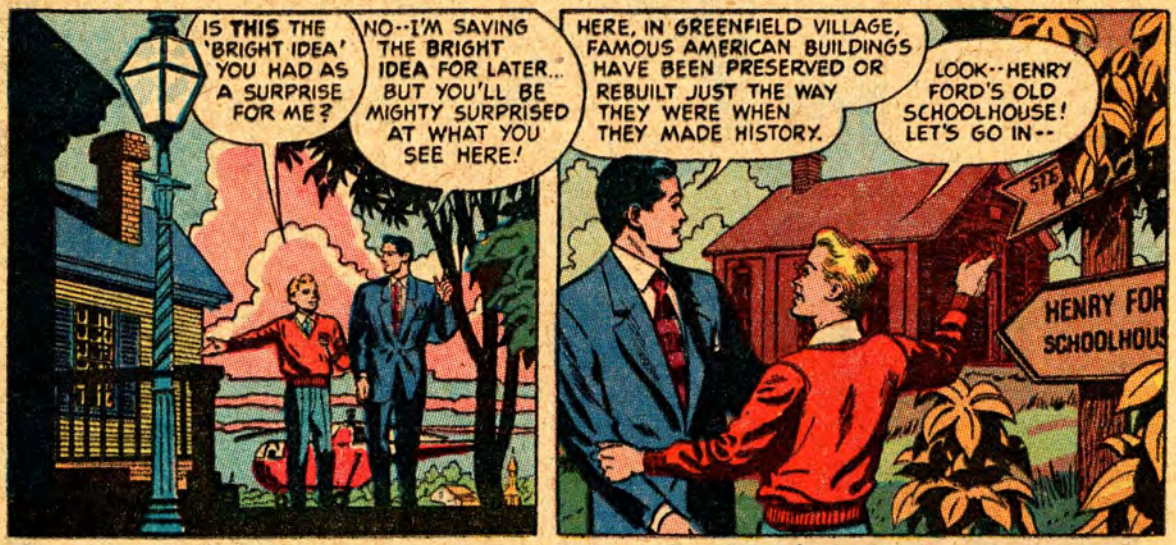
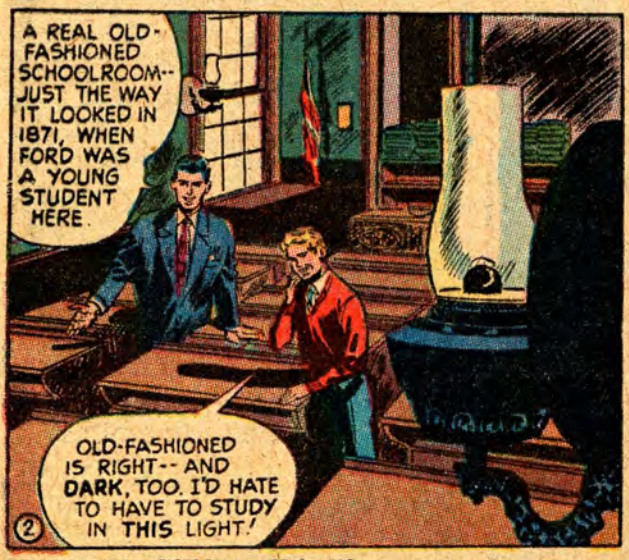
THE STORY OF LIGHT

ADVENTURES IN SCIENCE SERIES

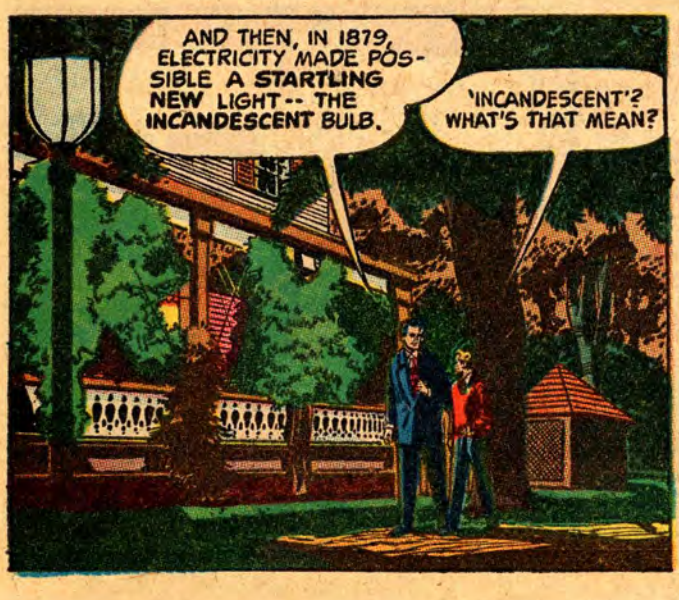
GENERAL ELECTRIC

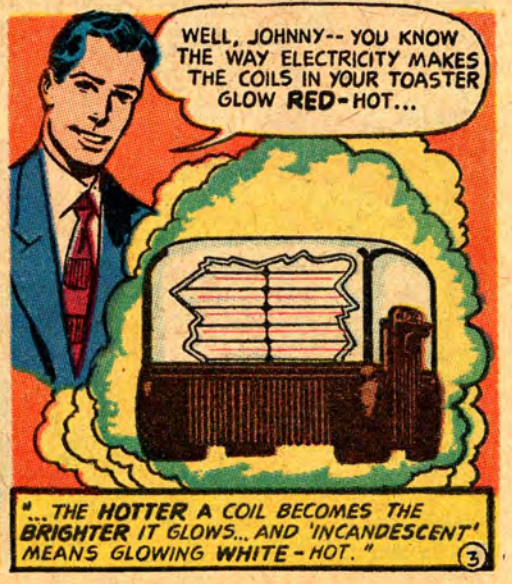







"SAVAGES USED THE LIGHT OF A FLAMING TORCH TO FIGHT OFF WILD BEASTS...
"IN ANCIENT GREECE, EVEN THE RICHEST MAN COULD HAVE ONLY THE POOREST LIGHT...
"THE CANDLES OF COLONIAL DAYS WERE HARD TO MAKE AND HAD TO BE USED SPARINGLY...
"AND EVEN AS LATE AS 1870, THE BEST LIGHT WAS A FLICKERING GAS LAMP...
"YES, AN OPEN FLAME WAS MAN'S ONLY KIND OF LIGHT FOR THOUSANDS OF YEARS."


AND THEN, IN 1879, ELECTRICITY MADE POSSIBLE A STARTLING NEW LIGHT-- THE INCANDESCENT BULB.
'INCANDESCENT'? WHAT'S THAT MEAN?


WELL, JOHNNY-- YOU KNOW THE WAY ELECTRICITY MAKES THE COILS IN YOUR TOASTER GLOW RED-HOT...
"...THE HOTTER A COIL BECOMES THE BRIGHTER IT GLOWS... AND 'INCANDESCENT' MEANS GLOWING WHITE-HOT."
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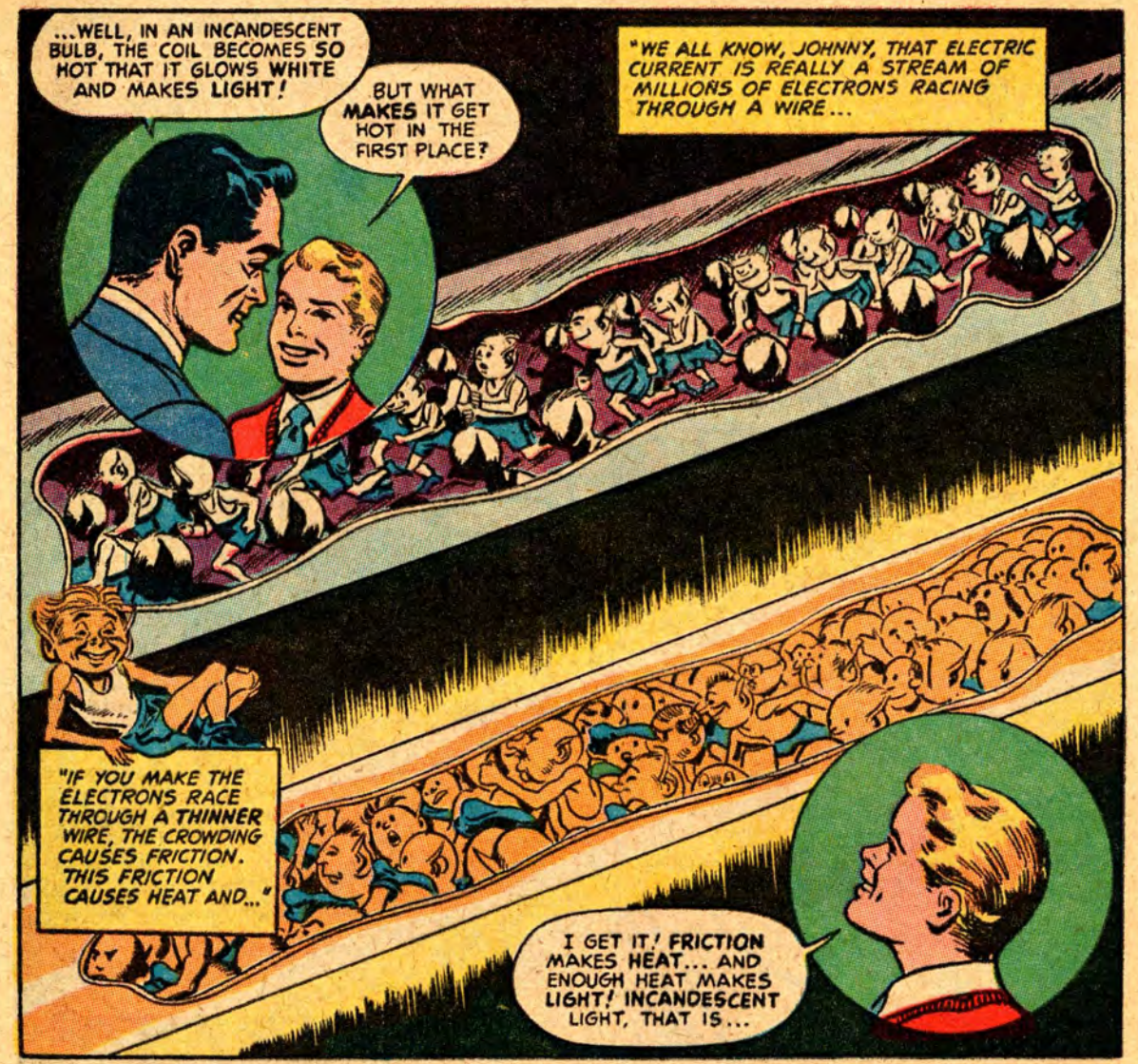
...WELL, IN AN INCANDESCENT BULB, THE COIL BECOMES SO HOT THAT IT GLOWS WHITE AND MAKES LIGHT!
BUT WHAT MAKES IT GET HOT IN THE FIRST PLACE?
"WE ALL KNOW, JOHNNY, THAT ELECTRIC CURRENT IS REALLY A STREAM OF MILLIONS OF ELECTRONS RACING THROUGH A WIRE...
"IF YOU MAKE THE ELECTRONS RACE THROUGH A THINNER WIRE, THE CROWDING CAUSES FRICTION. THIS FRICTION CAUSES HEAT AND..."
I GET IT! FRICTION MAKES HEAT... AND ENOUGH HEAT MAKES LIGHT! INCANDESCENT LIGHT, THAT IS...


RIGHT! AND IT WAS HERE, IN THOMAS EDISON'S WORK-SHOP, THAT THE FIRST PRACTICAL INCANDESCENT ELECTRIC LIGHT BULB WAS BORN!
THOMAS A. EDISON'S MENLO PARK LABORATORY
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JEEPERS! THE VERY ROOM WHERE EDISON MADE THE FIRST ELECTRIC LIGHT!
I SAID 'FIRST PRACTICAL', JOHNNY..


"YOU SEE, TOM EDISON HAD KNOWN THAT MANY SCIENTISTS BEFORE HIM HAD PRODUCED SOME SORT OF LIGHT WITH ELECTRICITY..."
In 1802 Sir Humphrey Davy heated metal strips with Electricity until they glowed dimly...
In 1820, De La Rue's heavy platinum wire in glass tube gave some light, too...
In 1840 Sir William Grove made a thick wire coil glow under a water-glass for a short time....
"THESE EARLY EXPERIMENTS USED A GREAT DEAL OF ELECTRICITY - YET DIDN'T BURN BRIGHT ENOUGH OR LONG ENOUGH TO BE PRACTICAL. THESE FAILURES CHALLENGED EDISON'S GENIUS AND GAVE BIRTH TO A NEW IDEA..."
THE SHORT, THICK MATERIALS THOSE FELLOWS USED DIDN'T GET HOT ENOUGH TO GIVE OFF MUCH LIGHT...
NOW, IF I COULD USE A LONG, THIN 'FILAMENT,' IT SHOULD BECOME WHITE-HOT...
BUT, MR. EDISON, IF IT'S TOO THIN, IT WILL BURN UP IN A FEW SECONDS!
NOT IF WE SEAL IT IN A VACUUM, JOHN. WITHOUT OXYGEN, IT CAN'T BURN UP!
"IN HIS EFFORTS TO MAKE A LONG, THIN FILAMENT, EDISON TRIED AND DISCARDED PLATINUM AND MANY OTHER METALS. HE FINALLY DECIDED THAT CARBON WOULD WORK--IF HE COULD FIND SOMETHING VERY THIN THAT COULD BE BAKED INTO A CARBON FILAMENT! NOTHING WAS TOO FAR-FETCHED FOR HIM TO TRY..."
PERHAPS I CAN CARBONIZE THIS BAMBOO BINDING...
LET'S CHAR ONE OF THOSE RED WHISKERS OF YOURS, MACKENZIE... MAKE YOUR HAIR REALLY GLOW!
MIND IF I BORROW YOUR SEWING-THREAD, DEAR? WE'VE TRIED JUST ABOUT EVERYTHING ELSE!
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"AND SO, AFTER TWO YEARS AND HUNDREDS OF EXPERIMENTS, THE GREAT INVENTOR'S SEARCH ENDED, STRANGELY ENOUGH, IN MRS. EDISON'S SEWING-BASKET..."
THE CARBONIZED THREAD WORKS... IT'S BEEN BURNING 40 HOURS, MR. EDISON!
I THINK WE'VE GOT IT! IF IT CAN BURN 40 HOURS, I CAN MAKE IT LAST A HUNDRED!
GOLLY, NO WONDER THEY CALLED HIM THE 'WIZARD OF MENLO PARK'!
'WIZARD' IS RIGHT!... BEFORE HIS BULB COULD BE PUT TO REALLY PRACTICAL USE, EDISON HAD TO DEVISE A WHOLE ELECTRIC SYSTEM USING A...
"--'PARALLEL CIRCUIT'... SO THAT YOU COULD TURN ANY BULB ON OR OFF WITHOUT AFFECTING THE OTHER BULBS."
"--'JUMBO' GENERATOR... POWERFUL ENOUGH TO LIGHT MANY HUNDREDS OF BULBS."
"--METER... TO MEASURE THE AMOUNT OF CURRENT USED BY EACH CUSTOMER."
"--FUSE... TO PROTECT THE SYSTEM AGAINST 'OVERLOADING'!"
"--SOCKET AND BULB BASE... TO PERMIT QUICK, EASY CHANGING OF BULBS."
"BEFORE LONG, EDISON'S NEW KIND OF LIGHT WAS TREMENDOUSLY POPULAR... BRIGHTENING THE LIVES OF THOUSANDS OF PEOPLE -- IN HOMES, SCHOOLS, OFFICE, FACTORIES AND STORES."
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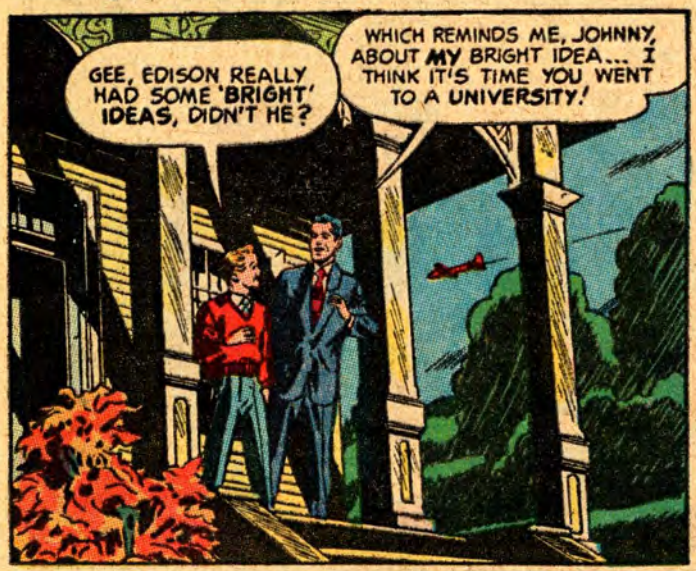
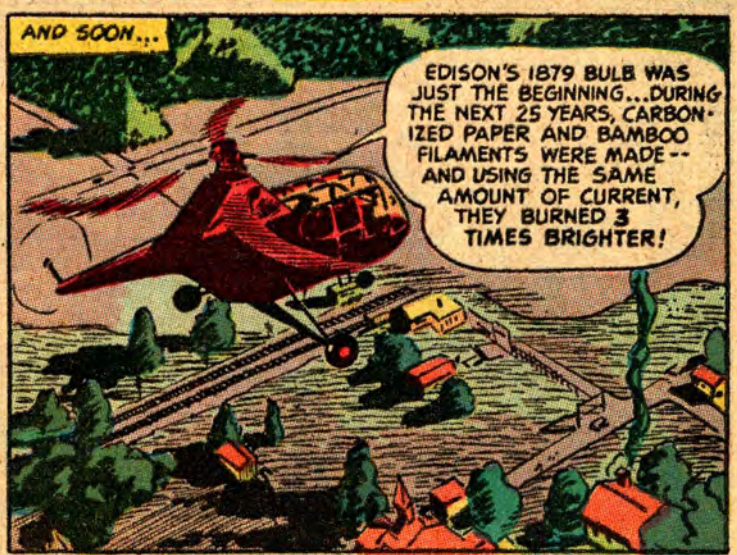
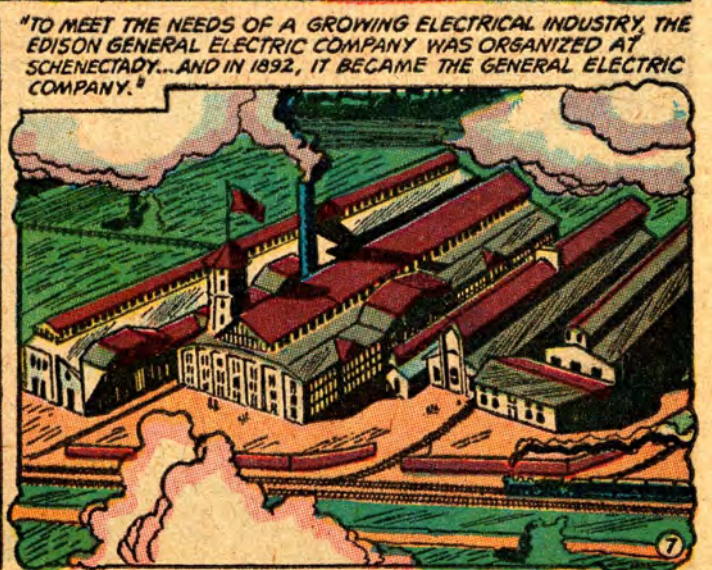

GEE, EDISON REALLY HAD SOME 'BRIGHT' IDEAS, DIDN'T HE?
WHICH REMINDS ME, JOHNNY, ABOUT MY BRIGHT IDEA... I THINK IT'S TIME YOU WENT TO A UNIVERSITY!


ME? UNIVERSITY? AT MY AGE?
YES, MY BOY.. THE UNIVERSITY OF LIGHT AT NELA PARK, CLEVELAND. YOU'LL SEE...


GOLLY, IT SURE WAS EXCITING TO SEE THE BIRTHPLACE OF TODAY'S BULB!
NOT EXACTLY TODAY'S BULB, JOHNNY. I'LL TELL YOU ABOUT THAT ON THE WAY..


AND SOON...
EDISON'S 1879 BULB WAS JUST THE BEGINNING...DURING THE NEXT 25 YEARS, CARBONIZED PAPER AND BAMBOO FILAMENTS WERE MADE -- AND USING THE SAME AMOUNT OF CURRENT, THEY BURNED 3 TIMES BRIGHTER!


AS THE BULB'S LIGHT INCREASED, ITS COST DECREASED! AND STILL THE SEARCH FOR IMPROVEMENT WENT ON...


"TO MEET THE NEEDS OF A GROWING ELECTRICAL INDUSTRY, THE EDISON GENERAL ELECTRIC COMPANY WAS ORGANIZED AT SCHENECTADY...AND IN 1892, IT BECAME THE GENERAL ELECTRIC COMPANY."


"THERE, AT THE GENERAL ELECTRIC RESEARCH LAB IN 1905, THE FIRST GREAT IMPROVEMENT WAS MADE..."
PERHAPS I COULD PREVENT THIS EARLY BLACKENING BY BAKING THE FILAMENT TO A HIGH TEMPERATURE BEFORE WE PUT IT IN THE BULB...
DR. WHITNEY, YOUR HEAT-TREATED FILAMENT IS NOT ONLY BRIGHTER BUT THE BULB DOESN'T BLACKEN SO MUCH!
"LATER, MORE EFFICIENT FILAMENTS WERE MADE, BUT THEY WERE VERY FRAGILE... OFTEN BROKE IN SHIPMENT AND COULDN'T STAND VIBRATION - UNTIL..."
A FLEXIBLE FILAMENT WOULD BE STRONGER... AND TUNGSTEN WOULD BE THE BEST METAL TO USE. NOW...
BUT, DR. COOLIDGE--NOBODY HAS BEEN ABLE TO FORM POWDERED TUNGSTEN INTO A SOLID BAR LET ALONE A WIRE!
"BUT IN 1911, AFTER SEVEN LONG YEARS OF CONSTANT EXPERIMENTING..."
I DIDN'T BELIEVE IT COULD BE DONE... A FLEXIBLE TUNGSTEN FILAMENT!
AND LOOK HOW IT STANDS THOSE JOLTS, JARS!
"AND IN 1912, TWO MORE GREAT ADVANCES..."
IF I PUT AN INACTIVE GAS, LIKE ARGON, INSIDE THE BULB, THE FILAMENT SHOULD LAST LONGER...
...ALSO, GENTLEMEN, IF WE COIL THE FILAMENT, WE CAN USE A MUCH LONGER ONE IN THE AVERAGE-SIZE BULB AND WE'LL HAVE A MUCH BRIGHTER LIGHT!
DR. LANGMUIR, YOUR GAS-FILLED BULB WITH THE COILED FILAMENT WILL BE THE BEST YET!
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A FEW HOURS LATER...
THERE IT IS, JOHNNY--THE G-E UNIVERSITY OF LIGHT! AND HERE WE GO FOR A CAMPUS LANDING!
IT LOOKS LIKE A UNIVERSITY, ALL RIGHT--BUT IS IT REALLY ONE?
IN A WAY IT IS. PEOPLE COME HERE FROM ALL OVER THE WORLD TO LEARN ABOUT GOOD LIGHTING.
AND SCIENTISTS GATHER HERE TO STUDY LIGHT--TO MAKE IT, TEST IT AND IMPROVE IT.
ALTHOUGH EACH BULB IS CHECKED OVER 480 TIMES DURING MANUFACTURE, SAMPLE BULBS ARE TESTED DAILY--FOR BRIGHTNESS, STRENGTH, UNIFORM LIFE!
HERE'S AN INTERESTING MACHINE, JOHNNY--THE PHOTOMETER, TO MEASURE EXACTLY THE AMOUNT OF LIGHT A BULB PRODUCES.
LOOKS LIKE A BIG BASEBALL SPLIT DOWN THE MIDDLE!
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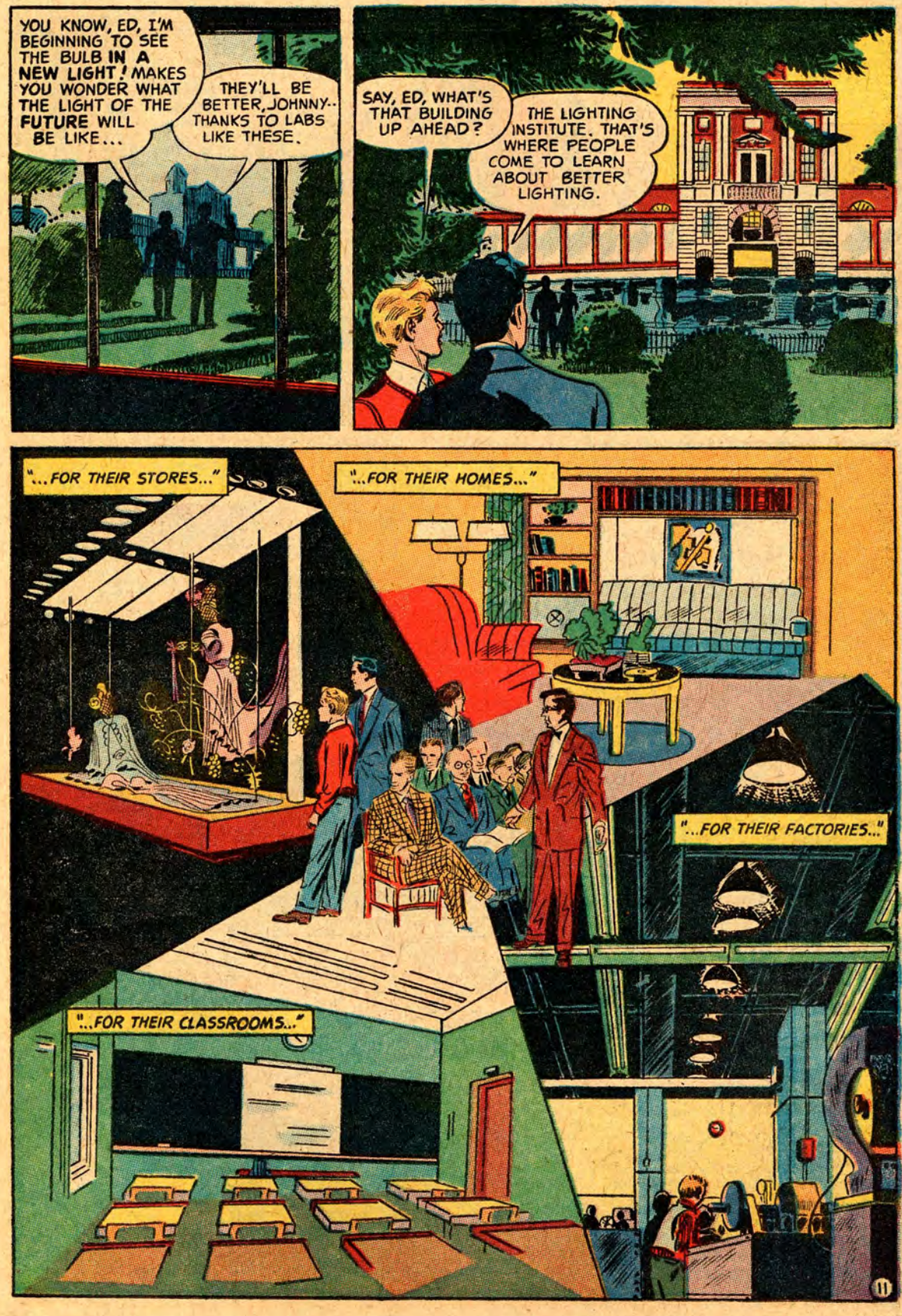
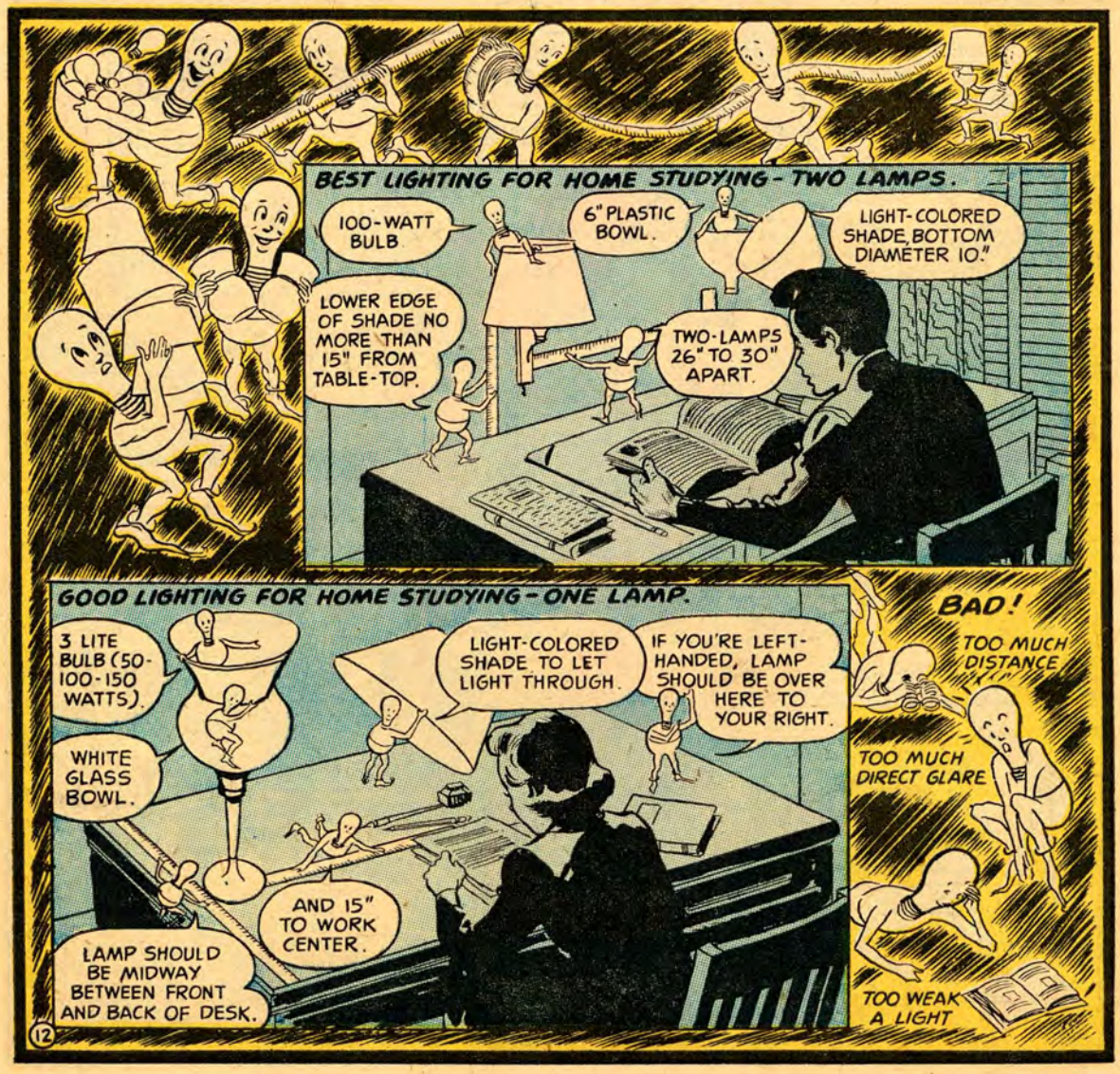
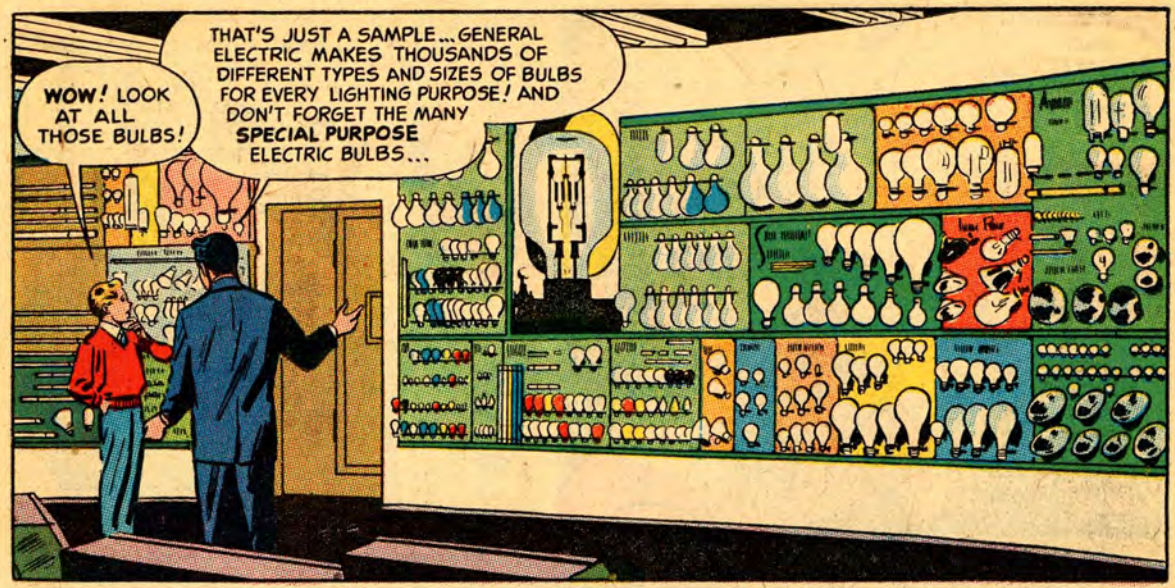
SAY, LOOK! -- THAT REVOLVING DRUM IS DROPPING THOSE BULBS RIGHT ON THEIR HEADS!
THAT'S THE 'TORTURE-RACK' THAT TESTS THEIR ABILITY TO TAKE PUNISHMENT.
AND HERE, THOUSANDS OF SAMPLE BULBS ARE CONSTANTLY BEING LIFE-TESTED.
GEE, THESE ARE PRETTY ROUGH 'PROVING-GROUNDS' FOR LIGHT BULBS, AREN'T THEY?
WELL, JOHNNY, PEOPLE DEPEND ON ELECTRIC LIGHT AND SO THE BULBS HAVE TO BE MADE DEPENDABLE!
--SAY, ED, IS THIS WHERE THE SCIENTISTS WORK?
DEVELOPMENT LABORAT
THAT'S RIGHT. IN LABS LIKE THESE, SCIENTISTS PRODUCED THE NON-SAG FILAMENT FOR LONGER LIFE... THE STRONGER TIPLESS BULB... THE BRIGHTER 'COILED-COIL' FILAMENT...
LOOK, JOHNNY--HERE'S WHERE MARVIN PIPKIN--THE G.E. SCIENTIST DEVELOPED THE 'INSIDE FROSTED' BULB IN 1925 -- AND JUST RECENTLY, THE IMPROVED 'ALL WHITE' BULB THAT'S EVEN EASIER ON THE EYES!


YOU KNOW, ED, I'M BEGINNING TO SEE THE BULB IN A NEW LIGHT! MAKES YOU WONDER WHAT THE LIGHT OF THE FUTURE WILL BE LIKE...
THEY'LL BE BETTER, JOHNNY.. THANKS TO LABS LIKE THESE.
SAY, ED, WHAT'S THAT BUILDING UP AHEAD?
THE LIGHTING INSTITUTE. THAT'S WHERE PEOPLE COME TO LEARN ABOUT BETTER LIGHTING.
"...FOR THEIR STORES..."
"...FOR THEIR HOMES..."
"...FOR THEIR FACTORIES..."
"...FOR THEIR CLASSROOMS..."


IN FACT, MORE THAN **30,000 PEOPLE A YEAR** COME HERE TO NELA PARK TO SEE AND STUDY LAMPS AND LIGHTING.
NO WONDER THEY CALL IT A 'UNIVERSITY'... THERE'S A LOT TO BE **LEARNED** IN A PLACE LIKE THIS!


'BETTER LIGHT FOR BETTER SIGHT' IS THE UNIVERSITY'S MOTTO. HERE'S A LIGHTING CHART FOR YOUR DESK AT HOME, JOHNNY!


BEST LIGHTING FOR HOME STUDYING - TWO LAMPS.
100-WATT BULB
6" PLASTIC BOWL.
LIGHT-COLORED SHADE, BOTTOM DIAMETER 10."
LOWER EDGE OF SHADE NO MORE THAN 15" FROM TABLE-TOP.
TWO-LAMPS 26" TO 30" APART.
GOOD LIGHTING FOR HOME STUDYING - ONE LAMP.
3 LITE BULB (50-100-150 WATTS).
LIGHT-COLORED SHADE TO LET LIGHT THROUGH.
IF YOU'RE LEFT-HANDED, LAMP SHOULD BE OVER HERE TO YOUR RIGHT.
WHITE GLASS BOWL.
AND 15" TO WORK CENTER.
LAMP SHOULD BE MIDWAY BETWEEN FRONT AND BACK OF DESK.
BAD!
TOO MUCH DISTANCE
TOO MUCH DIRECT GLARE
TOO WEAK A LIGHT


WOW! LOOK AT ALL THOSE BULBS!
THAT'S JUST A SAMPLE... GENERAL ELECTRIC MAKES THOUSANDS OF DIFFERENT TYPES AND SIZES OF BULBS FOR EVERY LIGHTING PURPOSE! AND DON'T FORGET THE MANY SPECIAL PURPOSE ELECTRIC BULBS...


"...FLASH-BULBS FOR HIGH-SPEED PHOTOGRAPHY.
"...INFRA-RED HEAT LAMPS FOR ACHING MUSCLES.
"...GERMICIDAL TUBES TO KILL GERMS IN THE AIR.
"...ULTRAVIOLET SUNLAMPS THAT TAN LIKE THE SUN.
"...THE AMAZING 'BLACK-LIGHT' USED IN CRIME DETECTION TO FIND FORGERIES."
"...'SHARP-FOCUS' BULBS FOR MOVIE PROJECTORS."
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AND HERE'S THE WORLD'S LARGEST BULB... 75,000 WATTS! -- USING ENOUGH POWER TO LIGHT 83 AVERAGE HOMES!

HERE'S THE **SMALLEST** LAMP IN THE WORLD... SMALLER THAN A GRAIN OF WHEAT! IT'S USED IN SURGICAL INSTRUMENTS FOR DELICATE OPERATIONS.

SAY, ED, WHAT ABOUT **FLUORESCENT** TUBES? DO THEY WORK THE SAME AS INCANDESCENT BULBS?

NO, INDEED, JOHNNY. THERE'S A BIG DIFFERENCE. YOU SEE...

"-- IN **INCANDESCENT** BULBS, LIGHT IS PRODUCED BY ELECTRONS SQUEEZING THROUGH A LONG, THIN COILED **FILAMENT** WHICH BECOMES **WHITE-HOT** AND **BRIGHT**..."

HERE'S THE **FILAMENT**, WHERE WE ELECTRONS GET ALL HOT AND BOTHERED.

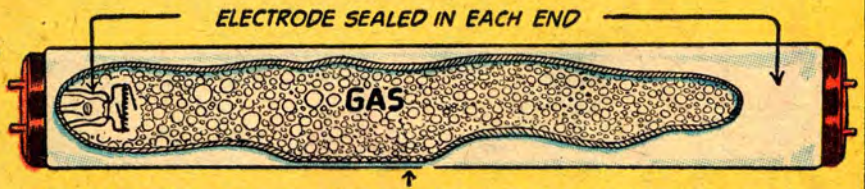
INERT GAS

SUPPORT WIRES (HOLD FILAMENT IN PLACE)

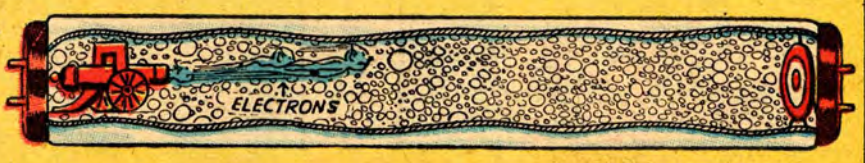
LEAD-IN WIRES (CARRY CURRENT TO FILAMENT)

BASE (CONNECTS BULB TO CIRCUIT)

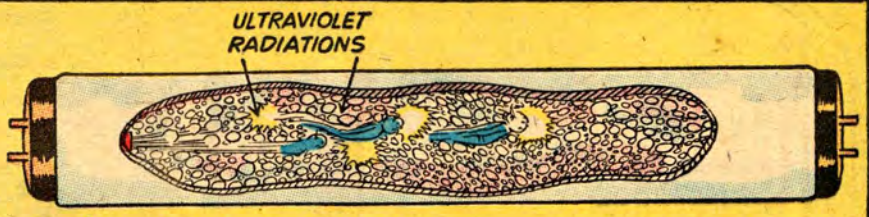
"BUT IN A **FLUORESCENT** TUBE, LIGHT IS PRODUCED BY ELECTRONS SHOOTING THROUGH A GAS-FILLED **SPACE**. IT'S COMPLICATED, BUT THIS WILL GIVE YOU AN IDEA..."



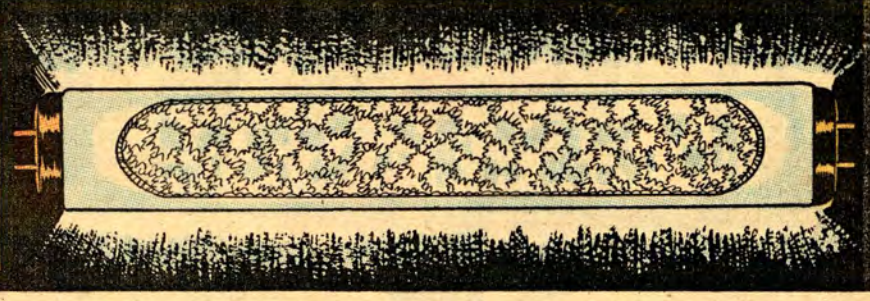
"AT THE STARTING SIGNAL (THE LIGHT SWITCH), THE **ELECTRODE** AT ONE END OF THE TUBE SHOOTS **ELECTRONS** THROUGH THE TUBE TOWARD THE ELECTRODE-TARGET AT THE OTHER END."



"BUT ON THE WAY TO THE TARGET, THE SPEEDING ELECTRONS HAVE TO CRASH THEIR WAY THROUGH THE MERCURY **VAPOR** IN THE TUBE... AND THESE **COLLISIONS** PRODUCE **ULTRA-VIOLET RADIATIONS...**"



"NOW WHEN THESE ULTRAVIOLET RADIATIONS HIT THE **PHOSPHOR-COATING** ON THE TUBE, THEY MAKE THE PHOSPHORS **FLUORESCE**-- GLOW WITH A SOFT COOL LIGHT!"



I GET IT--AND **THAT'S** WHY IT'S CALLED 'FLUORESCENT' LIGHT! IT HASN'T BEEN IN USE VERY LONG, HAS IT, ED?

NO, IT TOOK MANY YEARS TO MAKE IT GOOD ENOUGH AND CHEAP ENOUGH TO BE POPULAR... NELA PARK FIRST ANNOUNCED AND SOLD PRACTICAL FLUORESCENTS IN 1938.

THAT EDISON REALLY STARTED SOMETHING, DIDN'T HE?

EDISON STARTED THE WHOLE ELECTRICAL INDUSTRY, JOHNNY--

--THE DEMAND FOR HIS ELECTRIC LIGHT LED TO THE GREAT ELECTRICAL NETWORK THAT TODAY SERVES OUR HOMES, STORES AND FACTORIES.

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