

Industrial Ecology



As told by Dr. Frank Elwell

UNCLE SAM VS. THE WORLD



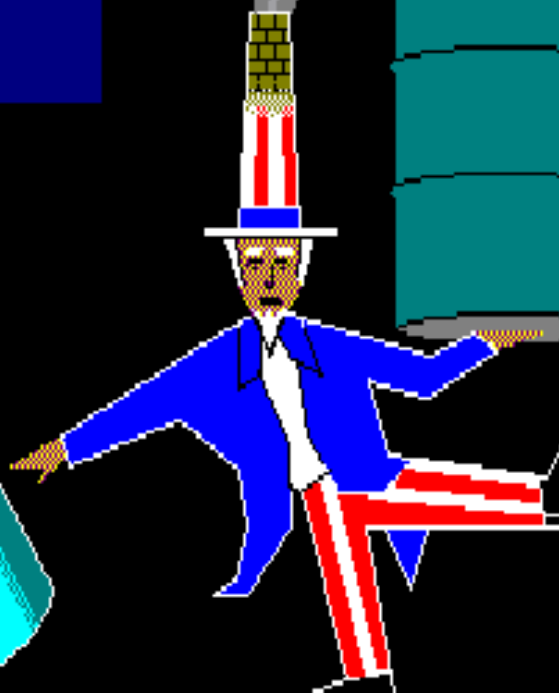
The U.S. has
5% of the
earth's
population,
but...

...produces 22% of the
world's carbon dioxide
emissions



...releases 26%
of the world's
nitrogen oxides

...disposes of
290 million
tons of toxic
waste



...uses 26%
of the world's oil

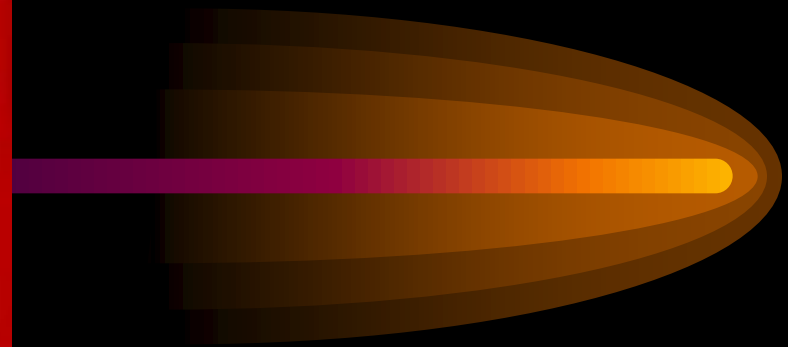
ESCAPE

PLANET OF THE YEAR **TIME**



Endangered Earth

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TIME



The Environment



THROUGHOUT HUMAN HISTORY,
PEOPLE'S ACTIVITIES HAVE HAD AN
ENORMOUS IMPACT ON THE
PHYSICAL WORLD, AND NEW
ENVIRONMENTAL PROBLEMS HAVE
BEEN CREATED BY THE SOLUTIONS
TO OLD ONES.

The Environment



EVEN THOUGH SOME CULTURES WERE ABLE TO CREATE RELATIVELY STABLE BALANCES BETWEEN PEOPLE AND THE NATURAL WORLD, OTHERS SLOWLY TURNED THE EARTH'S FORESTS INTO GRASSLANDS, ITS GRASSLANDS INTO DESERTS, AND ITS RIVERS INTO SEWERS.

The Environment

IN ORDER TO
UNDERSTAND THE
ENVIRONMENTAL
CRISIS, THE
HUMAN RACE
MUST BE VIEWED
AS A SINGLE
BIOLOGICAL
SPECIES LIVING IN
A SINGLE
ENVIRONMENT.



The Environment



- ATMOSPHERE
- WATER
- LAND
- ENERGY
- RESOURCE DEPLETION

ATMOSPHERE



- AIR POLLUTION
- GLOBAL WARMING
- OZONE DEPLETION

AIR POLLUTION



THROUGH THE FEDERAL CLEAN AIR ACT AMERICA HAS ADDRESSED SEVERAL PROBLEMS. OIL COMPANIES HAVE BEEN FORBIDDEN TO ADD LEAD TO THEIR GASOLINE, SAVING MANY CHILDREN FROM SICKNESS AND MENTAL RETARDATION.

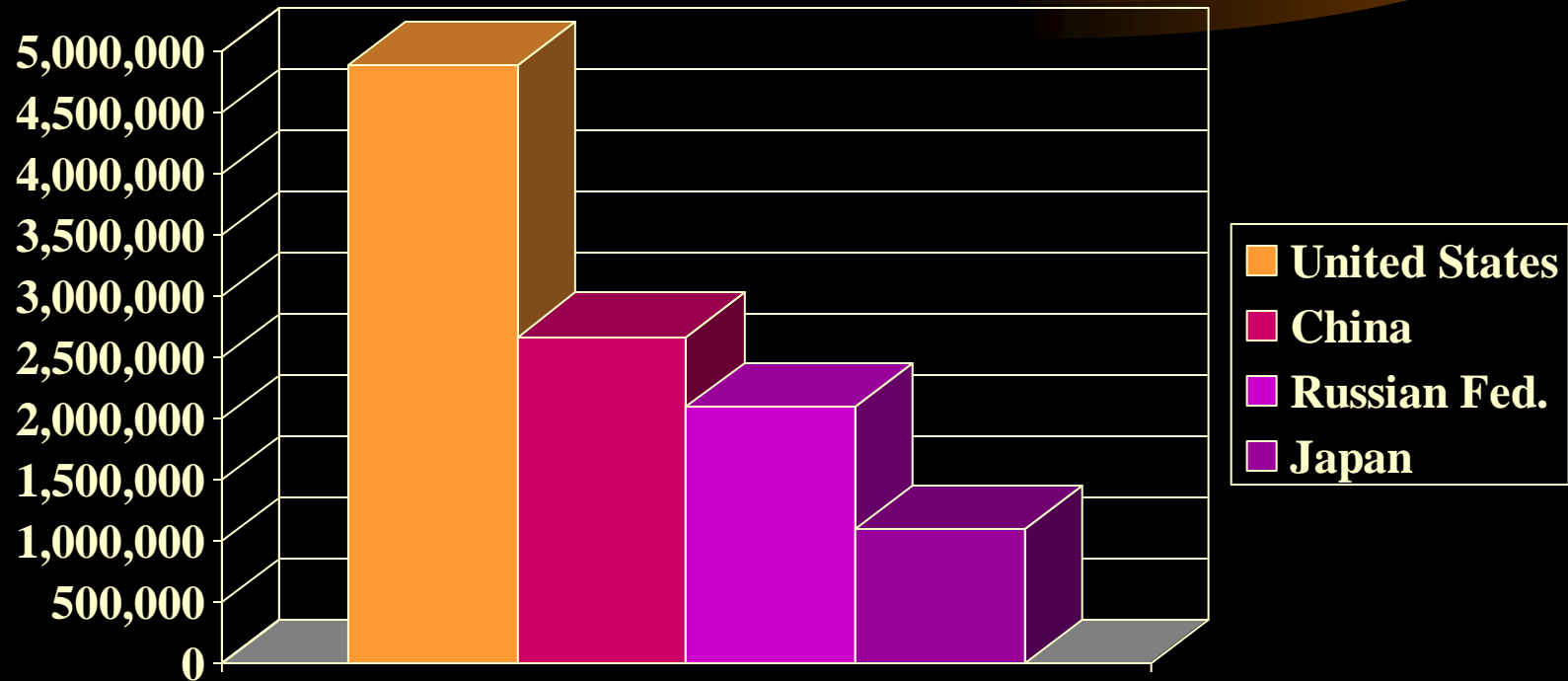
AIR POLLUTION

- BUT MANY AIR POLLUTION PROBLEMS STILL REMAIN:
 - OZONE POLLUTION
 - ACID RAIN
 - CARBON MONOXIDE
 - SOOT
 - TOXIC CHEMICALS
 - RADIOACTIVE GASES AND PARTICLES



Pollutant	Major Sources	Comments
Carbon monoxide (CO)	Motor-vehicle exhaust; some industrial processes	Health standard: 10 mg /m ³ (9 ppm) over 8 hr; 40 mg /m ³ over 1 hr (35 ppm)
Sulfur dioxide (SO₂)	Heat and power generation facilities that use oil or coal-containing sulfur; sulfuric acid plants	Health standard: 80 µg /m ³ (0.03 ppm) over a year; 365 µg /m ³ over 24 hr (0.14 ppm)
Suspended particulate matter (TSP)	Motor-vehicle exhaust; industrial processes; refuse incineration; heat and power generation; reaction of pollution gases in the atmosphere	Health standard: 75 µg /m ³ over a year; 260 µg /m ³ over 24 hr; composed of carbon, nitrates, sulfates, and many metals including lead, copper, iron, & zinc.
Lead (Pb)	Motor-vehicle exhaust; lead smelters; battery plants	Health standard: 1.5 µg /m ³ over 3 months; most of lead contained in TSP
Nitrogen oxides (NO, NO₂)	Motor vehicle exhaust; heat and power generation; nitric acid; explosives fertilizer plants.	Health standard: 100 µg /m ³ (0.05 ppm) over a year for NO ₂ ; react with hydrocarbons and sunlight to form photochemical oxidants
Photochemical oxidants (primarily ozone O₃ ; also peroxyacetyl nitrate [PAN] and aldehydes)	Formed in the atmosphere by reaction of nitrogen oxides, hydrocarbons, and sunlight	Health standard: 235 mg /m ³ (0.12 ppm) over 1 hr.
Nonmethane hydrocarbons (includes ethane, ethylene, propane, butanes, pentanes, acetylene)	Motor-vehicle emissions; solvent evaporation; industrial processes; solid waste disposal; fuel combustion	React with nitrogen oxides and sunlight to form photochemical oxidants
Carbon dioxide (CO₂)	All combustion sources	Possibly injurious to health at concentrations greater than 5000 ppm over 2-8 hr; atmospheric levels have increased from about 280 ppm a century ago to over 350 ppm at present; this trend may be contributing to the greenhouse effect

Carbon Dioxide Emissions



Carbon Dioxide

If China's economy continues to grow at the same rapid pace, by 2030 it will emit more carbon dioxide than all industrialized countries combined.



Kim Westerskov, Oxford Scientific Films

OZONE

BESIDES BEING POISONOUS TO
BREATHE, OZONE HAS A BAD
EFFECT ON AGRICULTURE.



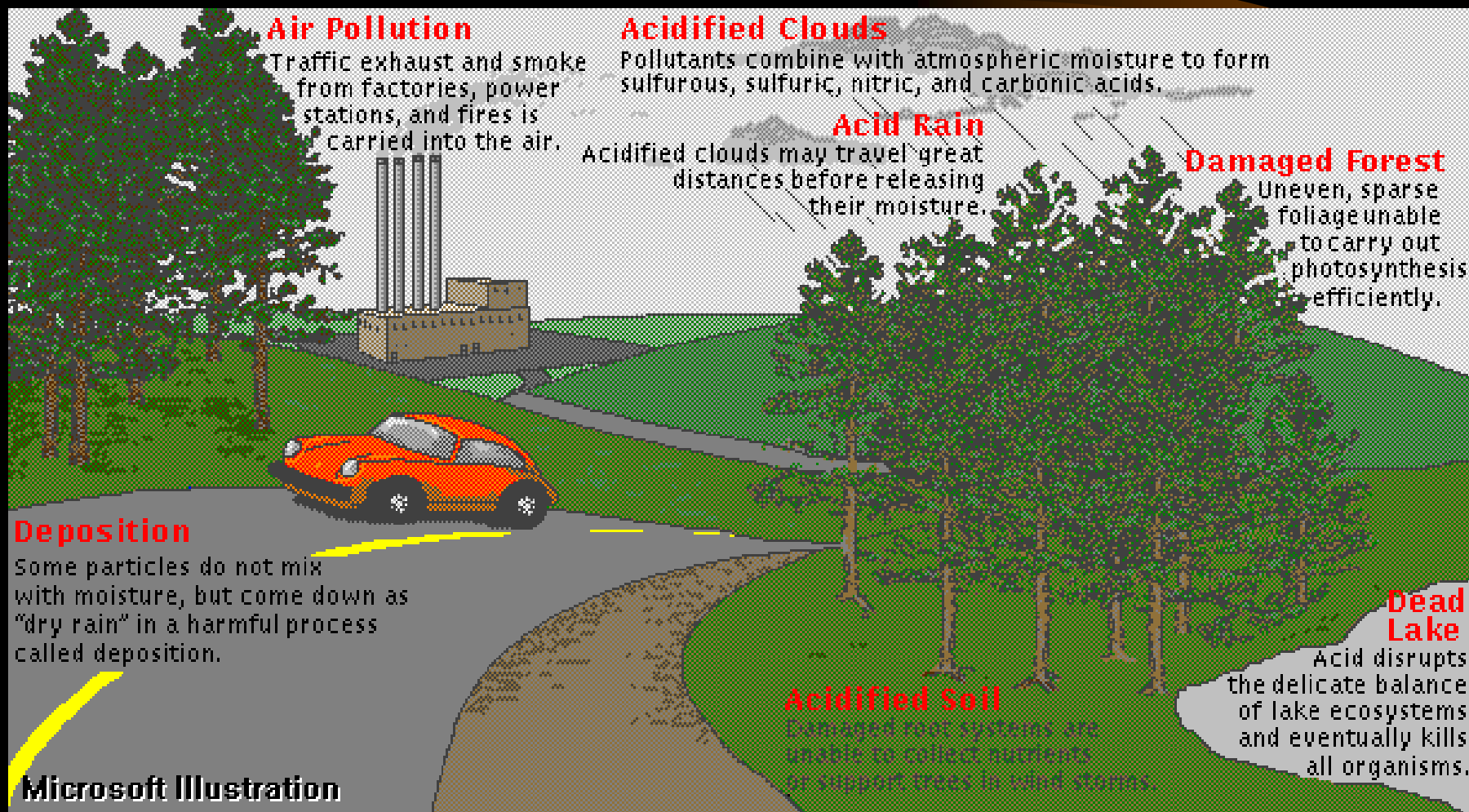
Sean Morris, Oxford Scientific Fi

ACID RAIN

ACID RAIN IS ALMOST AS DAMAGING
AS OZONE TO LIVING THINGS.



Steffen Hauser, Oxford Scientific



Air Pollution

Traffic exhaust and smoke from factories, power stations, and fires is carried into the air.

Acidified Clouds

Pollutants combine with atmospheric moisture to form sulfurous, sulfuric, nitric, and carbonic acids.

Acid Rain

Acidified clouds may travel great distances before releasing their moisture.

Damaged Forest

Uneven, sparse foliage unable to carry out photosynthesis efficiently.

Deposition

Some particles do not mix with moisture, but come down as "dry rain" in a harmful process called deposition.

Acidified Soil

Damaged root systems are unable to collect nutrients or support trees in hard storms.

Dead Lake

Acid disrupts the delicate balance of lake ecosystems and eventually kills all organisms.

Microsoft Illustration

CARBON MONOXIDE

DAMAGES HEALTH,
LARGELY BY
INTERFERING WITH
THE BLOOD'S
ABILITY TO
TRANSPORT OXYGEN
TO THE BRAIN AND
OTHER ORGANS.



Wesley Bocxe, Photo Researchers, Inc.


















TOXIC CHEMICALS

TOXIC CHEMICALS COME OUT OF TRACE COMPOUNDS IN FOSSIL FUELS, TO A LARGE EXTENT FROM INDUSTRIAL PROCESSES AND, PROBABLY MOST OF ALL, FROM THE BURNING OF WASTE IN INCINERATORS.



Rafael Macra, Photo Researcher

TOXIC CHEMICALS

Country	Annual Domestic waste (tons)	Equivalent per person (Kilograms)	
Australia	10,000,000	680	
Belgium	3,082,000	313	
Canada	12,600,000	525	
Denmark	2,046,000	399	
Finland	1,200,000	399	
France	15,500,000	288	
Great Britain	15,816,000	282	
Italy	14,041,000	246	
Japan	40,225,000	288	
Netherlands	5,400,000	381	
New Zealand	1,528,000	488	
Norway	1,700,000	415	
Spain	8,028,000	214	
Sweden	2,500,000	300	
Switzerland	2,146,000	336	
United States	200,000,000	875	
Microsoft Table	20,780,000	337	

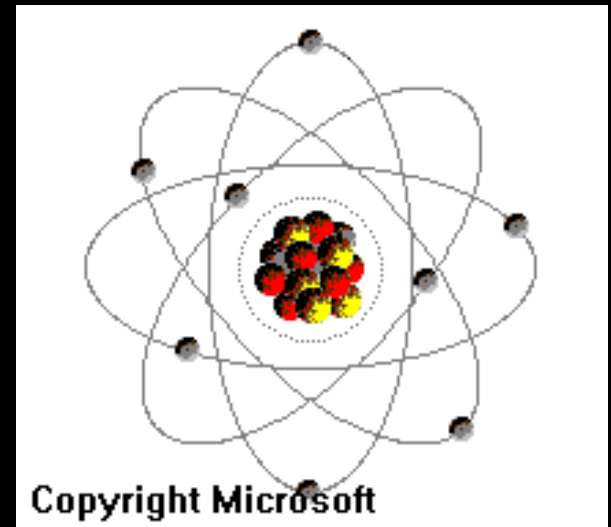
RADIOACTIVE GASES AND PARTICLES



SOME OF THE RADIOACTIVE
POLLUTANTS SURVIVE FOR TENS OF
THOUSANDS OF YEARS, AND THEY
CAN GO RIGHT ON CAUSING
CANCERS AND BIRTH DEFECTS FOR
ALL OF THAT TIME.

RADIOACTIVE GASES AND PARTICLES

THE WORST EFFECTS OF RADIOACTIVE FALLOUT ARE ON LIVING THINGS; THEY CAUSE BIRTH DEFECTS, THEY MAKE CROPS INEDIBLE AND THEY KILL.



SOOT

SOOT IS THE MOST VISIBLE
POLLUTANT FROM COMBUSTION. IT
IS MADE UP OF LITTLE PARTICLES
OF SOLID MATTER WHICH HAVE NOT
BURNED COMPLETELY.



Eric Kamp, Phototake NYC

A decorative graphic consisting of a horizontal bar with a color gradient from dark blue on the left to bright orange on the right. To the right of the bar is a large, stylized, brown and orange comet-like tail pointing towards the right.

SOOT

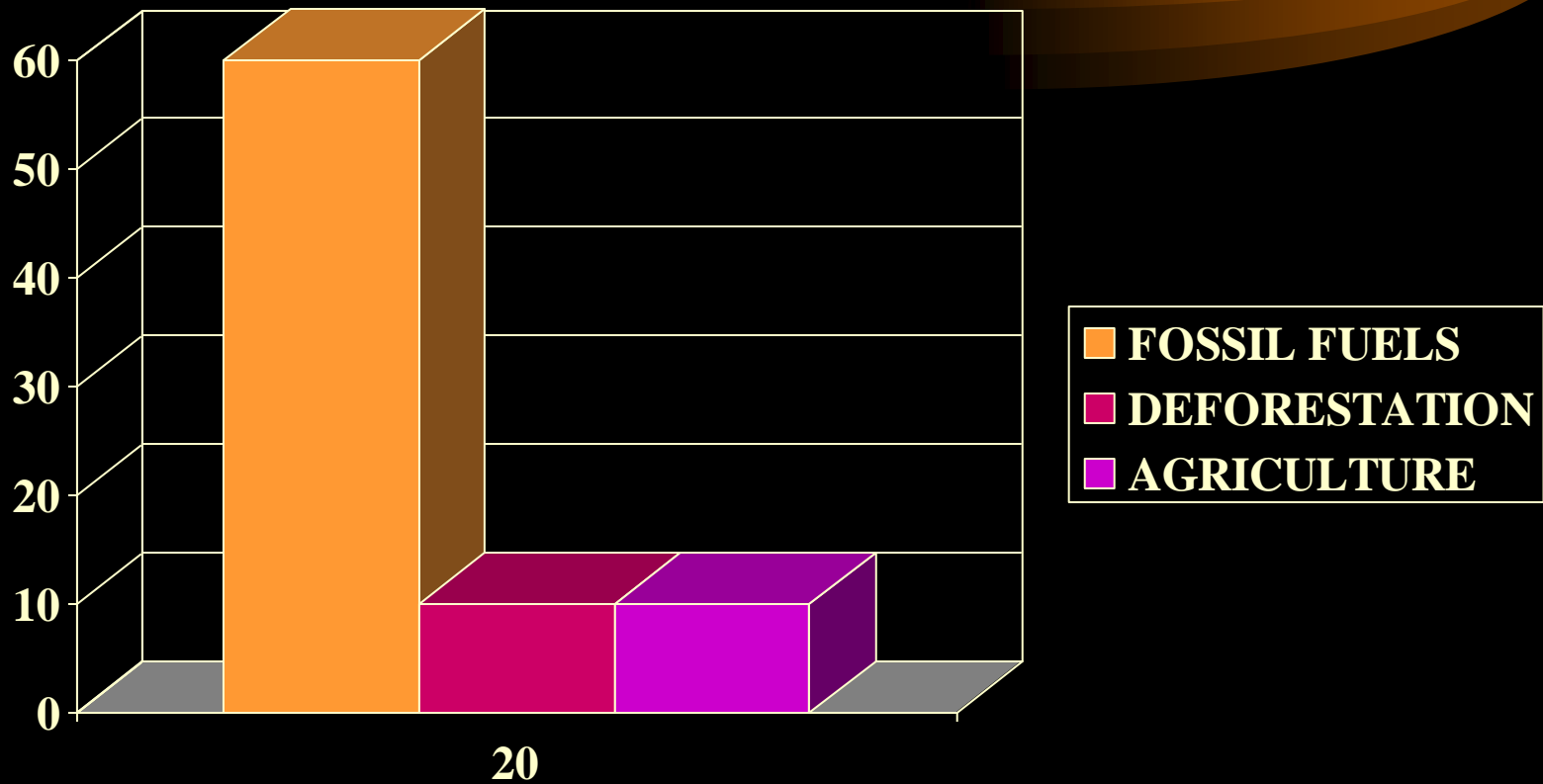
THE PARTICLES ARE SMALL ENOUGH
SO THAT THEY FLOAT IN THE AIR
FOR A FAIRLY LONG PERIOD
BEFORE THEY PRECIPITATE OUT ON
YOUR WINDOWSILL--OR YOUR
LUNGS.

GLOBAL WARMING

CERTAIN GASES IN
THE ATMOSPHERE
TRAP HEAT AND
KEEP THE EARTH
WARM, MUCH AS
THE GLASS OF A
GREENHOUSE
KEEPS THE AIR
INSIDE WARM.



GLOBAL WARMING



GLOBAL WARMING

THE CUTTING OF
TREES FOR
CLEARING LAND,
ENERGY NEEDS,
AND LUMBER
PRODUCTS ALSO
CONTRIBUTE TO
THE GREENHOUSE
EFFECT.



GLOBAL WARMING

TROPICAL RAIN FORESTS, AS WELL AS TEMPERATE DRY FORESTS, ARE BEING DESTROYED RAPIDLY. AT PRESENT RATES, SOME CRITICAL FOREST TYPES WILL BE GONE IN A FEW YEARS, AND MOST OF THE TROPICAL FORESTS WILL BE GONE BEFORE THE END OF THE NEXT CENTURY.



GLOBAL WARMING



- 1850 THERE WAS 270 PARTS CARBON DIOXIDE TO A MILLION PARTS OF AIR
- BY 1957 THAT HAD GROWN TO 315 PARTS PER MILLION
- BY 1990 THAT HAD GROWN TO MORE THAN 350 PARTS PER MILLION

GLOBAL WARMING



CURRENTLY THE CARBON DIOXIDE
CONTENT OF AIR IS INCREASING AT
THE RATE OF 3.6% PER YEAR.

GLOBAL WARMING



VIRTUALLY ALL SCIENTISTS AGREE
THAT THIS BUILDUP OF
GREENHOUSE GASES HAS THE
POTENTIAL TO PRODUCE DRAMATIC
CLIMATE CHANGES.

GLOBAL WARMING



EVIDENCE FROM A VARIETY OF
SOPHISTICATED SUPER-COMPUTER
MODELS INDICATE THAT SOME
GLOBAL WARMING IS LIKELY OVER
THE NEXT SEVERAL GENERATIONS.

GLOBAL WARMING

- AT FIRST BLUSH, GLOBAL WARMING MAY NOT SEEM TO BE SUCH A BAD THING.
- BUT WARMING THE EARTH WILL NOT TURN LONG ISLAND INTO TAHITI.
- THE ATMOSPHERE IS BASICALLY A HEAT ENGINE FUELED BY DIFFERENCES IN TEMPERATURE.



Kathleen Campbell, ALLSTOCK, I

GLOBAL WARMING: WEATHER



THE MORE HEAT ENERGY THAT THE GREENHOUSE GASES TRAP IN THE ATMOSPHERE THE HARDER THE BLOWING WINDS AND THE MOVEMENT OF AIR MASSES FROM PLACE TO PLACE.

GLOBAL WARMING: WEATHER

ONE OF THE MOST DAMAGING EFFECTS IS LIKELY TO BE INCREASES IN VIOLENT WEATHER. WE MAY ALREADY BE SEEING THIS HAPPENING, IN SUCH DEVASTATING RECENT HURRICANES AS GILBERT AND HUGO, IN THE SUMMERS OF 1988 AND 1989.



GLOBAL WARMING: WEATHER

TORNADOES AND MICROBURSTS CAN
ALSO BE EXPECTED TO PICK UP IN
FREQUENCY AND INTENSITY.



GLOBAL WARMING: WEATHER



SURPRISINGLY, EVEN RECORD COLD SNAPS MAY BE PART OF THE PHENOMENON. THE COLD AIR IS NOT ANY COLDER THAN BEFORE, IT IS JUST IN A DIFFERENT PLACE THAN USUAL--BROUGHT DOWN FROM THE ARTIC BY THE MOVEMENT OF AIR MASSES.

GLOBAL WARMING: WEATHER

GLOBAL WARMING IS
LIKELY TO AFFECT
LOCAL WEATHER
PATTERNS WHICH
WOULD SERIOUSLY
DAMAGE SOME
IMPORTANT FARM
AREAS IN THE
WORLD.



GLOBAL WARMING: WEATHER

THE AMERICAN
MIDWEST--THE
"BREADBASKET"--
COULD BE
PARTICULARLY
HARD HIT.
PROTRACTED
DROUGHTS AND
STRONG WINDS
WOULD DRY OUT
THE SOIL.



GLOBAL WARMING: SEA LEVEL

A decorative graphic consisting of a horizontal bar with a color gradient from dark blue on the left to bright yellow on the right. To the right of the bar is a large, stylized, brown and orange comet-like shape pointing towards the right.

THE MUCH ANTICIPATED RISING SEA
LEVEL IS NOT DUE TO MELTING ICE
IN THE ANTARCTIC--THAT IS NOT
EXPECTED TO HAPPEN FOR A GOOD
WHILE.



Garry D. McMichael, Photo Researchers, Inc.

GLOBAL WARMING: SEA LEVEL



- RATHER IT IS PREDICATED ON THERMAL EXPANSION--WATER EXPANDS A LITTLE WITH RISING TEMPERATURES.
- AS A MATTER OF OBSERVED FACT, THE SEA IS ALREADY RISING IN MANY PLACES AROUND THE EARTH.

GLOBAL WARMING: SEA LEVEL



- EVEN A SMALL RISE WOULD BE ENOUGH TO ENDANGER LOW-LYING SHORE AREAS.
- THE BEST CURRENT MATHEMATICAL MODELS MAKE IT CLEAR THAT SOME PLACES WILL BE AFFECTED MORE THAN OTHERS.

GLOBAL WARMING: SEA LEVEL

THE U.N. INTER-
GOVERNMENTAL
PANEL ON CLIMATE
CHANGE ESTIMATED
THAT A THREE FOOT
RISE WOULD
SUBMERGE A
QUARTER OF A
MILLION MILES OF
THE WORLD'S
COASTLINES.



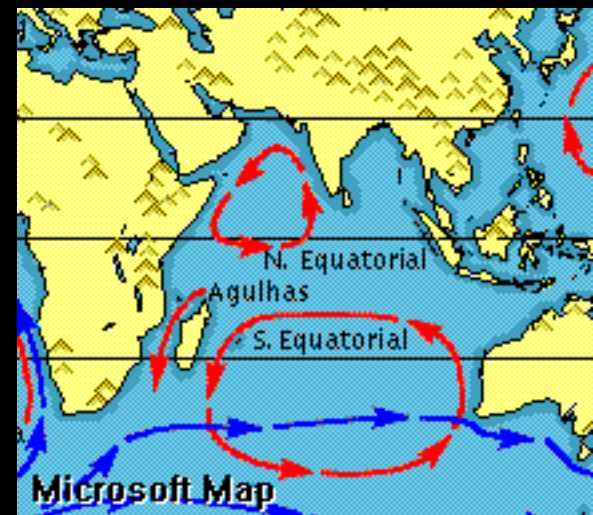
GLOBAL WARMING: SEA LEVEL

A decorative graphic consisting of a horizontal bar with a color gradient from dark blue on the left to bright yellow on the right. To the right of the bar is a large, dark, comet-like shape with a pointed tip pointing towards the right, containing the end of the horizontal bar.

THIS, THEY SAID, WOULD "SERIOUSLY
THREATEN LOW-LYING URBAN
AREAS, FLOOD PRODUCTIVE LAND,
CONTAMINATE FRESH WATER
SUPPLIES AND DESTROY MANY
COASTAL WETLANDS." MORE THAN
100 MILLION PEOPLE WOULD BE
DISPLACED.

GLOBAL WARMING: The Sea

CURRENTS, TEMPERATURE AND
RAINFALL PATTERNS WOULD SHIFT
IN UNPREDICATABLE WAYS.
NATURAL ECOSYSTEMS WOULD BE
DEVASTATED.



GLOBAL WARMING: FORESTS

PERHAPS 1/3 OF THE
WORLD'S FORESTS
MIGHT FIND
THEMSELVES
LIVING IN THE
WRONG PLACES.



Mike Birkhead, Oxford Scientific

GLOBAL WARMING: FORESTS



TREES, LIKE EVERY OTHER LIVING
THING, HAVE EVOLVED TO SURVIVE
MOST SUCCESSFULLY IN THE
CLIMATIC ZONES THEY ARE IN.

GLOBAL WARMING: FORESTS

THIS PUTS THEM AMONG THE MOST
VULNERABLE OF LIVING THINGS TO
CLIMATE CHANGE.



GLOBAL WARMING: FORESTS



- MOST ANIMALS CAN MOVE--TREES CAN NOT, AND SO RAPID CHANGE OF CLIMATE MEANS DEATH.
- IN A MAN-MADE, ACCELERATED GLOBAL WARMING THE FORESTS WON'T HAVE THE TIME TO ADJUST. THEY WILL SIMPLY DIE.



Greg Ryan/Bally Beyer, ALLSTOCK, INC.

GLOBAL WARMING: AGRICULTURE



AS THE EARTH WARMS, THE ZONES OF CLIMATE WILL MOVE AWAY FROM THE EQUATOR AND TOWARD THE POLES; IN THE U.S., THEY WILL MOVE NORTH.

GLOBAL WARMING: AGRICULTURE

FINALLY, AGRICULTURAL PATTERNS
WILL ALSO HAVE TO CHANGE IN
RESPONSE TO CLIMATIC CHANGE.



GLOBAL WARMING: AGRICULTURE



CROPS WHICH NOW THRIVE IN
KANSAS MAY WELL FIND THE
TEMPERATURES AND RAIN
PATTERNS THEY NEED FARTHER
NORTH IN ALBERTA.

GLOBAL WARMING: AGRICULTURE



WHETHER THEY WILL THRIVE THERE
IS ANOTHER QUESTION: NORTHERN
SOILS ARE GENERALLY THINNER
AND LESS FERTILE.

GLOBAL WARMING



- IF YOU SET OUT TO DESIGN A PROBLEM THAT HUMAN INSTITUTIONS CAN'T DEAL WITH, YOU COULDN'T FIND A BETTER ONE THAN GLOBAL WARMING.
- THE DRACONIAN MEASURES NECESSARY TO LIMIT EMISSIONS (OR TO ROLL THEM BACK) ARE JUST NOT POLITICALLY FEASIBLE.

OZONE DEPLETION



BEGINNING IN THE 1970S SCIENTISTS BECAME CONCERNED WITH OZONE DEPLETION. THESE CFC GASES, INCLUDING FREON, WERE WIDELY USED IN AIR CONDITIONERS, REFRIGERATORS, AND AEROSOL SPRAYS.

OZONE DEPLETION



- IN 1986 THE NIMBUS SATELLITE DETECTED DEPLETION OF THE OZONE BARRIER OVER THE NORTH POLE.
- IN THAT YEAR SCIENTISTS CALCULATED THAT THE EARTH HAD LOST 3 PERCENT OF ITS OZONE SHIELD SINCE 1920, MOST OF IT DURING THE 1970s.

OZONE DEPLETION

BY 1992, THIS AREA HAD INCREASED TO OVER 9 MILLION SQUARE MILES (3 X U.S.). THE OZONE IN THIS AREA WAS 80% THINNER THAN NORMAL.



OZONE DEPLETION: CAUSES

A decorative graphic consisting of a horizontal bar with a color gradient from dark blue on the left to bright yellow on the right, ending in a pointed, comet-like shape.

- NITROGEN OXIDE
- CHLOROFLUOROCARBON (CFC)

OZONE DEPLETION: EFFECTS



MOST LIFE ON EARTH CANNOT LONG
ENDURE THE SUN'S ULTRAVIOLET
RAYS WITHOUT THE PROTECTION OF
AN OZONE LAYER.

OZONE DEPLETION: EFFECTS



YOU KNOW WHAT A NORMAL
SUNBURN IS LIKE. YOUR EXPOSED
SKIN TURNS RED. IF THE BURN IS
BAD ENOUGH, YOUR SKIN BECOMES
HOT AND PAINFUL.

OZONE DEPLETION: EFFECTS



- THEN BLISTERS FORM AND BREAK, AND THE SURFACE LAYERS OF THE SKIN ACTUALLY PEEL AWAY TO EXPOSE NEW SKIN GROWING UNDERNEATH IT.
- WHAT KILLS THE CELLS ON THE SURFACE IS A RANGE OF FREQUENCIES IN THE LIGHT FROM THE SUN CALLED "ULTRAVIOLET RAYS."

OZONE DEPLETION: EFFECTS



THE SUN PRODUCES THESE RAYS IN LARGE QUANTITIES, BUT THEY DON'T ALL REACH THE SURFACE OF THE EARTH. WE ARE SHIELDED FROM THE WORST OF THEM BY THE PRESENCE OF A SMALL AMOUNT OF THE GAS OZONE IN THE UPPER LEVELS OF OUR ATMOSPHERE.

OZONE DEPLETION: EFFECTS



IF THE OZONE LOSS IS GREAT ENOUGH, THE DAMAGE FROM THE EXCESS ULTRAVIOLET RADIATION WILL NOT BE LIMITED TO ADDITIONAL SKIN CANCERS AND CATARACTS. THE HEALTH OF THE WHOLE BODY IS AT RISK.

OZONE DEPLETION: EFFECTS



THE HUMAN BODY'S IMMUNE
SYSTEMS ARE WEAKENED IN A
PERSON SUBJECTED TO EXCESSIVE
ULTRAVIOLET.

OZONE DEPLETION: EFFECTS



WHEN THEY ARE DAMAGED
INFECTIOUS DISEASES OF EVERY
KIND CAN INCREASE, FROM THE
COMMON COLD TO LEPROSY, AS
THE NATURAL DEFENSES AGAINST
DISEASE LOSE SOME OF THEIR
EFFECTIVENESS.

OZONE DEPLETION: EFFECTS



- PERHAPS THE MOST FINALLY DANGEROUS EFFECT OF EXCESSIVE ULTRAVIOLET RADIATION WILL BE WHAT IT DOES TO THE WORLD'S PLANT AND ANIMAL LIFE.
- HUMANS CAN WEAR SUNBLOCKER, STAY INDOORS, WEAR HATS AND SUNGLASSES. ANIMALS CANNOT.

OZONE DEPLETION: EFFECTS



THE EFFECT OF INCREASING
ULTRAVIOLET RADIATION WILL BE
FELT IN LOWERED YIELDS FROM
THE WORLDS FARMS--AND
ULTIMATELY IN CROP FAILURES
AND FAMINES.

OZONE DEPLETION



THE GOOD NEWS IS THAT THE WORLD IS RAPIDLY CUTTING DOWN ON THE MANUFACTURE OF CFCs (ACCORDING TO A 1987 TREATY PRODUCTION WAS TO BE CUT IN HALF).

OZONE DEPLETION



**THE BAD NEWS IS THAT WE STILL
PRODUCE SOME, WE ALSO
PRODUCE OTHER OZONE
DESTROYING GASES NOT
COVERED BY THE TREATY.**

OZONE DEPLETION



IF WE STOPPED PRODUCING CFCs
TODAY--WHICH IS NOT GOING TO
HAPPEN--THERE WOULD STILL BE
SIGNIFICANT OZONE LOSS
CONTINUING WELL INTO THE 21st
CENTURY FROM WHAT IS ALREADY
IN THE ATMOSPHERE.

WATER



- POLLUTION OF LAKES, RIVERS, AQUIFERS AND OCEANS
- SCARCITY OF FRESH WATER SUPPLIES
- DESTRUCTION OF HABITAT AND SPECIES EXTINCTION

Water

WHEN WE TALK
ABOUT WHAT IS
GOING WRONG WITH
OUR WATER
SUPPLIES, IT HAS THE
SAME OLD-
FASHIONED SOUND
AS TALKING ABOUT
THE POLLUTION OF
OUR AIR.



Water



- UNFORTUNATELY WATER PROBLEMS ARE STILL WITH US.
- IT IS A FACT THAT, APART FROM ITS DRY SOUTHWESTERN STATES, THE U.S. IS BLESSED BY NATURE WITH PLENTIFUL SUPPLIES OF FRESH WATER.

Water: Cities

ONE REASON FOR OUR
WATER PROBLEMS IS
THAT WE BUILD GREAT
CITIES TO HOLD OUR
PEOPLE IN PLACES WHERE
THERE IS NOT ENOUGH
NATURAL WATER TO
SUPPLY THEM.



Ronald Toms, Oxford Scientific F

Water: Cities



LOS ANGELES HAS ENOUGH NATURAL WATER SUPPLY FOR ABOUT 1 MILLION--THEY NOW HAVE 14 MILLION. LOS VEGAS, PHOENIX, AND OTHER CITIES HAVE SIMILAR PROBLEMS. THEY SUCK UP ALL AVAILABLE WATER IN THEIR REGION.



Ken Biggs, Photo Researchers, Inc.

Water: Agriculture



AGRICULTURE IS ACTUALLY WORSE.
ABOUT 85% OF CALIFORNIA WATER
ACTUALLY GOES TO THE STATE'S
FARMERS. MUCH OF THIS IS
WASTED ON IRRIGATING PASTURE
LAND, AND ILL ADVISED
IRRIGATION PROJECTS.



Richard Hansen, Photo Researchers, Inc.

Water: Aquifers

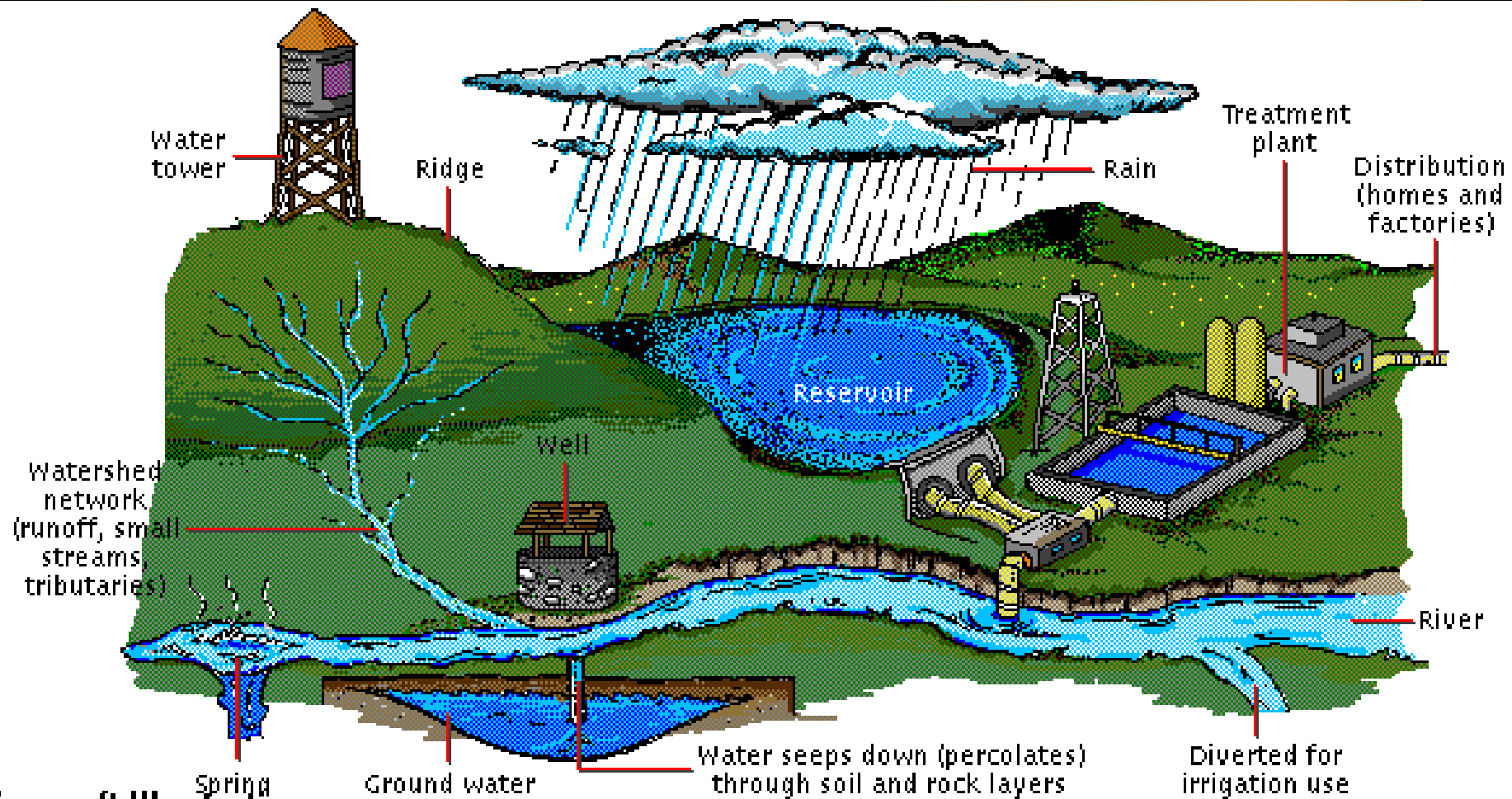


WELL WATER, TOO, IS BECOMING
BOTH DIRTIER AND SCARCER ALL
OVER THE COUNTRY.

Water: Aquifers



UNDERGROUND WATER IS FOSSIL WATER. IT MAY HAVE TAKEN THOUSANDS OF YEARS FOR THE AQUIFER TO FILL. IF YOU NOW PUMP FASTER THAN IT CAN RECHARGE IT WILL SOONER OR LATER GO DRY.



Water: Aquifers



- THE OGALLALA AQUIFER UNDERLIES THE HIGH PLAINS STATES FROM SOUTH DAKOTA TO TEXAS.
- IT SUPPORTS 20% OF AMERICA'S IRRIGATED FARMS. BUT THE IMMENSE AQUIFER IS BEING DRAINED.

Water: Aquifers



IN PARTS OF THE SOUTHWEST THE
WATER TABLE OF THE OGALLALA
HAS FALLEN BY DOZENS OF FEET--
BY 2020 THERE WILL BE NO WATER
LEFT SOUTH OF NEBRASKA.

Water: Aquifers



IN MANY PLACES WHERE THERE IS
PLENTY OF WATER NEARBY
SEEPAGE OF AGRICULTURAL AND
INDUSTRIAL POLLUTION HAS
RUINED UNDERGROUND WELLS
FOR HOUSEHOLDERS.

Water: Aquifers



IN FLORIDA EXCESSIVE PUMPING HAS LOWERED THE UNDERGROUND WATER LEVELS NEAR THE SEA SHORES SO MUCH THAT SALT WATER IS SEEPING INTO THE AQUIFERS.

Water: Aquifers

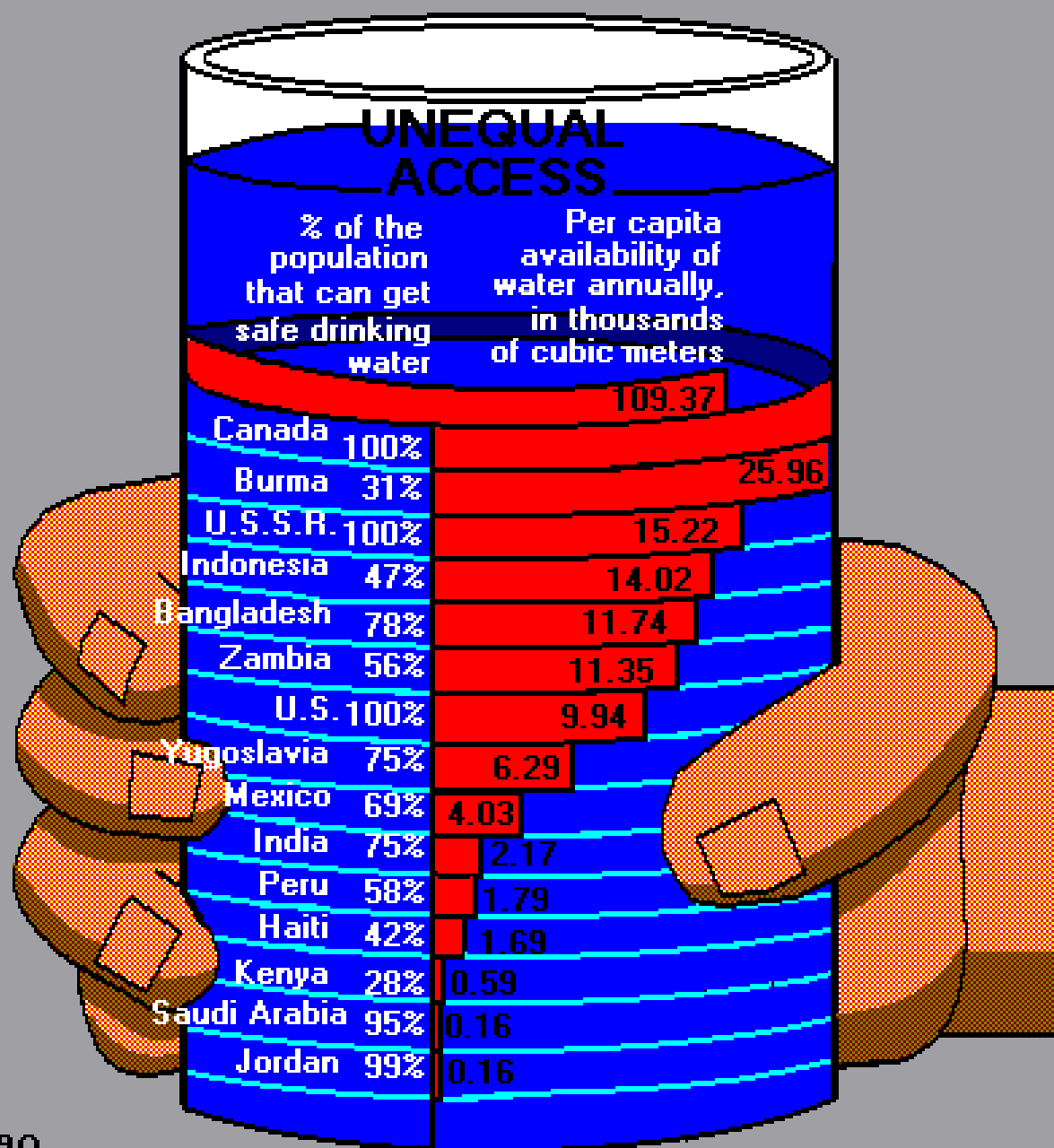
HEEDLESS
EXPLOITATION OF
DEPLETABLE
GROUND WATER
SUPPLIES
ENDANGERS FOOD
PRODUCTION AND
OTHER ESSENTIAL
HUMAN SYSTEMS.



Water: Shortages



HEAVY DEMANDS ON THE WORLD'S
WATER SUPPLIES HAVE RESULTED
IN SERIOUS SHORTAGES IN SOME 80
COUNTRIES, CONTAINING 40% OF THE
WORLD'S POPULATION.



WATER: RIVERS

THE CAPACITY OF THE MISSISSIPPI RIVER HAS BEEN STRETCHED TO THE LIMIT IN ALL OF ITS USES, FOR DRINKING, FOR TRANSPORT AND FOR IRRIGATION.



WATER: RIVERS



THE REAL HEALTH PROBLEM IN USING MISSISSIPPI RIVER WATER IS THE LOAD OF CONTAMINATION BY INDUSTRIAL WASTE. THIS WASTE IS BEYOND THE CAPACITIES OF MOST MUNICIPAL WATER SYSTEMS, WHICH DO LITTLE TO COPE WITH INDUSTRIAL POLLUTION.



Ben Osborne, Oxford Scientific Films

WATER: RIVERS



BY THE TIME THE MISSISSIPPI WATER
GETS TO LOUISIANA IT IS ALREADY
CARRYING A BURDEN OF SUCH
POISONOUS WASTES AS PCBs AND
HEAVY METALS.

WATER: RIVERS



THAT PART OF LOUISIANA HAS ONE
OF THE HIGHEST RATES OF DEATHS
FROM CANCER OF LUNG, STOMACH,
RECTUM AND GALLBLADDER IN THE
COUNTRY.

WATER: LAKES

VAST AS THEY ARE, THE GREAT LAKES ARE SERIOUSLY POLLUTED--IN THE CASE OF LAKE MICHIGAN, TO SUCH AN EXTENT THAT PREGNANT WOMEN IN THAT AREA ARE ADVISED NOT TO EAT LAKE FISH MORE THAN ONCE A WEEK.



WATER: LAKES



- IT WOULD COST AN ESTIMATED \$100 BILLION TO CLEAN UP THE GREAT LAKES.
- IN COMPARISON: ALL THE CLEANUP EFFORTS OF THE PAST TWENTY YEARS COMBINED HAVE AMOUNTED TO ONLY A TENTH THAT MUCH.

Water: Oceans



DESTRUCTIVE PRESSURE ON THE OCEANS IS SEVERE, PARTICULARLY IN THE COASTAL REGIONS WHICH PRODUCE MOST OF THE WORLD'S FOOD FISH.



Vanessa Vick, Photo Researchers, Inc.

Water: Oceans



THE TOTAL MARINE CATCH IS NOW
ABOVE THE ESTIMATED
SUSTAINABLE LIMITS. SOME
FISHERIES HAVE ALREADY SHOWN
SIGNS OF COLLAPSE.

Water: Oceans



RIVERS CARRY HEAVY BURDENS OF
ERODED SOIL INTO THE SEAS ALSO
CARRY INDUSTRIAL, MUNICIPAL,
AND AGRICULTURAL WASTE--SOME
OF IT TOXIC.



Nova Scotia Dept. of Tourism



Laurence Gould, Oxford Scientific Films



LAND



- LOSS OF AGRICULTURAL LAND
- CHEMICAL POLLUTION
- DESERTIFICATION
- DESTRUCTION OF FORESTS
- LANDFILL SHORTAGES
- DESTRUCTION OF HABITAT AND SPECIES EXTINCTION

LAND

A decorative graphic consisting of a horizontal bar with a color gradient from dark blue on the left to bright orange on the right. To the right of the bar is a large, stylized comet-like tail that curves upwards and to the right, with a color gradient from dark brown to bright orange.

SINCE 1945, 11% OF THE EARTH'S
VEGETATED SURFACE HAS BEEN
DEGRADED, AND PER CAPITA FOOD
PRODUCTION IN MANY PARTS OF
THE WORLD IS DECREASING.

LAND



SOME 65 COUNTRIES DEPENDING ON
SUBSISTENCE FARMING MAY BE
UNABLE TO FEED THEIR
POPULATIONS BY THE YEAR 2000.

LAND



The issue is rapidly becoming one of human survival. The world's population is growing faster than its ability to produce food.



LAND

AS A RESULT OF ENVIRONMENTAL
DEGRADATION, THE GAP BETWEEN
THE "HAVE" NATIONS AND THE
"HAVE NOT" NATIONS CONTINUES
TO WIDEN.





LAND

IRREVERSIBLE LOSS OF PLANT AND ANIMAL SPECIES, WHICH BY 2100 MAY REACH 1/3 OF ALL SPECIES NOW LIVING, IS ESPECIALLY SERIOUS.





LAND

WE ARE LOSING THE POTENTIAL THEY
HOLD FOR PROVIDING MEDICINAL
AND OTHER BENEFITS AND THE
CONTRIBUTION THAT GENETIC
DIVERSITY OF LIFE FORMS GIVES TO
THE ROBUSTNESS OF THE WORLD'S
BIOLOGICAL SYSTEMS.





NATURAL RESOURCES



- UNEQUAL DISTRIBUTION
- WASTEFUL CONSUMPTION AND PRODUCTION PATTERNS
- RENEWABLE RESOURCE SHORTAGES (FOOD, WOOD)
- NONRENEWABLE RESOURCE LIMITS (RAW MATERIALS)
- HAZARDS OF NUCLEAR ENERGY

HUMAN HEALTH



- THREATENED BY POISONS,
CARCINOGENS, AND DISEASE
ORGANISMS
- THREATENED BY MUTAGENIC
SUBSTANCES

UNCHECKED POLLUTION



EVEN A PARTIAL REDUCTION IN
POLLUTION IS DEFINITELY WORTH
HAVING, EVEN AT A HIGH COST.
ALL WE NEED TO DO IS TO LOOK AT
THE PARTS OF THE WORLD THAT
HAVE LET POLLUTION RUN
UNCHECKED, FOR EXAMPLE THE
COUNTRIES OF EASTERN EUROPE.



UNCHECKED POLLUTION

A decorative graphic consisting of a horizontal bar with a color gradient from dark blue on the left to bright yellow on the right. Below this bar is a large, stylized arrow pointing to the right, filled with a gradient from dark brown to light brown.

NIKEL A MINING TOWN IN THE
FORMER SOVIET UNION, PRODUCES
SOME 140,000 TONS OF METAL. THE
SMELTERS PRODUCE HALF A
MILLION TONS OF SULFUR DIOXIDE
WHICH FALL ALL OVER THE AREA
AS ACID RAIN.

UNCHECKED POLLUTION



THE ENTIRE NEXT-DOOR NATION OF
NORWAY COLLECTIVELY EMITS ONLY
HALF THAT MUCH SULFUR DIOXIDE.

UNCHECKED POLLUTION



AROUND NIKEL HUNDREDS OF
SQUARE MILES OF FOREST ARE
SIMPLY DEAD. THERE ARE NO
LIVING FISH IN THE RIVERS. EVEN
GRASS, WHEN SPARSE BLADES OF IT
TRY TO COME UP IN THE SPRING,
TURNS BROWN AND DIES.



UNCHECKED POLLUTION



NIKEL'S VOLUNTEER WORKERS FROM
OTHER PARTS OF THE SOVIET UNION
RARELY STAY MORE THAN TEN
YEARS--NINE OUT OF TEN OF THEM
LEAVE WITH PERMANENT LUNG
DAMAGE.

UNCHECKED POLLUTION

THIS DISPUTE THE FACT THAT DURING
THEIR WORKING HOURS THEY BREATHE
FILTERED AIR THROUGH A MASK.



UNCHECKED POLLUTION



IN CRACOW, POLAND, TOURISTS ARE ADVISED NOT TO REMAIN IN THE CITY FOR MORE THAN THREE DAYS BECAUSE OF DANGEROUS AIR POLLUTION. THE RESIDENTS ARE FAR WORSE OFF.

UNCHECKED POLLUTION



- THE RATE OF DEATHS FROM CANCER IS SLIGHTLY LOWER THAN IN THE REST OF POLAND...
- CRACOW'S PEOPLE DON'T LIVE LONG ENOUGH TO SUFFER FROM SOME OF THE DISEASES OF AGING.

UNCHECKED POLLUTION

IN COPSA MICA, ROMANIA, THE IMMN
CHEMICAL WORKS SPECIALIZES IN
HEAVY METALS, AND EMITS 30,000
TONS OF METAL-LADEN SOOT EACH
YEAR.



Kim Westerskov, Oxford Scientific

UNCHECKED POLLUTION



COPSA MICA'S WORKERS ARE HEALTHY WHEN HIRED, BUT A YEAR LATER THEY HAVE UP TO 800 TIMES THE PERMISSIBLE LEVEL OF LEAD IN THEIR BLOOD, AND ALMOST 3/4 OF THEM SUFFER FROM LEAD-INDUCED ANEMIA.

UNCHECKED POLLUTION



IN CZECHOSLOVAKIA, AS MANY AS
10% OF INFANTS BORN IN SOME
AREAS, SUCH AS NORTHERN
BOHEMIA, ARE AFFECTED BY BIRTH
DEFECTS, AND THE SUNLIGHT
THROUGHOUT THE AREA IS
DESCRIBED AS "BLEAK AND GRAY."

UNCHECKED POLLUTION



- IN THE TOWN OF TEPLICE CHILDREN ARE KEPT INDOORS FOR AS MUCH AS A MONTH AT A TIME;
- IN THE SIX WORST WEEKS OF THE YEAR THE SCHOOL AND ALL ITS CHILDREN ARE MOVED TO ANOTHER COMMUNITY WITH CLEANER AIR

UNCHECKED POLLUTION



IN BUDAPEST, HUNGARY, HOSPITALS
HAVE INSTALLED "INHALITORIUMS"
--BOXES THE SIZE OF TELEPHONE
BOOTHES, WHERE PATIENTS WAIT IN
LINE FOR FIFTEEN MINUTES OF
BREATHING CLEANED AIR.

UNCHECKED POLLUTION

ONE HUNGARIAN
DEATH IN EACH
SEVEN IS
ATTRIBUTED TO
POLLUTION.



UNCHECKED POLLUTION



- IN PARTS OF CZECHOSLOVAKIA AND POLAND AS MANY AS 3/4 OF THE TREES ARE DAMAGED OR DEAD FROM ACID RAIN, AND THE REST OF THE REGION IS NEARLY AS BAD.
- FARM ANIMALS SICKEN, EVEN VEGETATION IS DAMAGED OR KILLED.



Steffen Hauser, Oxford Scientific Films

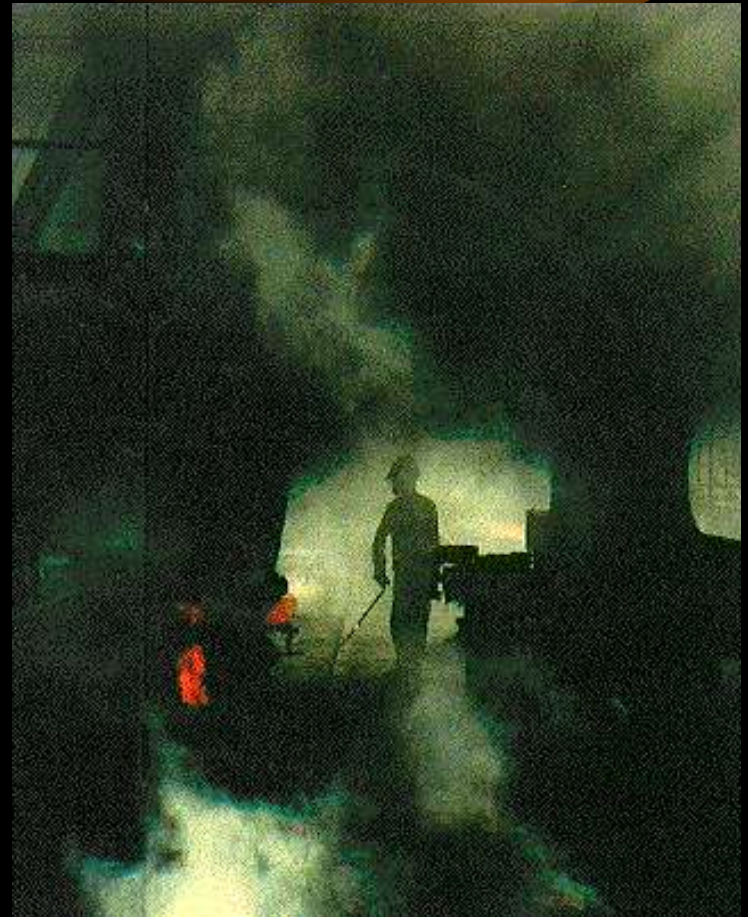
UNCHECKED POLLUTION



IN SOME AREAS OF THE EAST HUMAN
LIFE EXPECTANCY IS AS MUCH AS
SEVEN YEARS LESS THAN EVEN
COMPARATIVELY CLEANER PLACES
NEARBY.

UNCHECKED POLLUTION

FOR MORE THAN 70
YEARS THE
COUNTRIES OF
EASTERN EUROPE
HAVE BURNED
LOCAL BROWN COAL
DEPOSITS, HEAVILY
CONTAMINATED
WITH SULFUR AND
OTHER CHEMICALS.



UNCHECKED POLLUTION

THE RESULT IS
THAT THE AIR
STINKS, THE
LAND AND
WATER IS
DYING, AND THE
PEOPLE'S
HEALTH IS IN
DECLINE.



UNCHECKED POLLUTION

THE GROSS NATIONAL PRODUCT OF
POLAND IS DIMINISHED BY AN
ESTIMATED 10% FROM POLLUTION OF
VARIOUS KINDS--ABOUT HALF OF THAT
FROM WORKERS SICKNESS.



UNCHECKED POLLUTION

THERE ARE
AREAS OF THE
FORMER EAST
GERMANY
WHERE THE AIR
POLLUTION IS
STILL SO BAD
THAT DOCTORS
REFUSE TO
WORK THERE.



UNCHECKED POLLUTION

- ALL OF THIS COULD HAVE BEEN AMERICA IF WE HAD NOT BEGUN TO TAKE AT LEAST A FEW FIRST STEPS.
- MORE IS NEEDED.

