HIS 2129

Technology, Society and Environment since 1800

(Winter 2014)

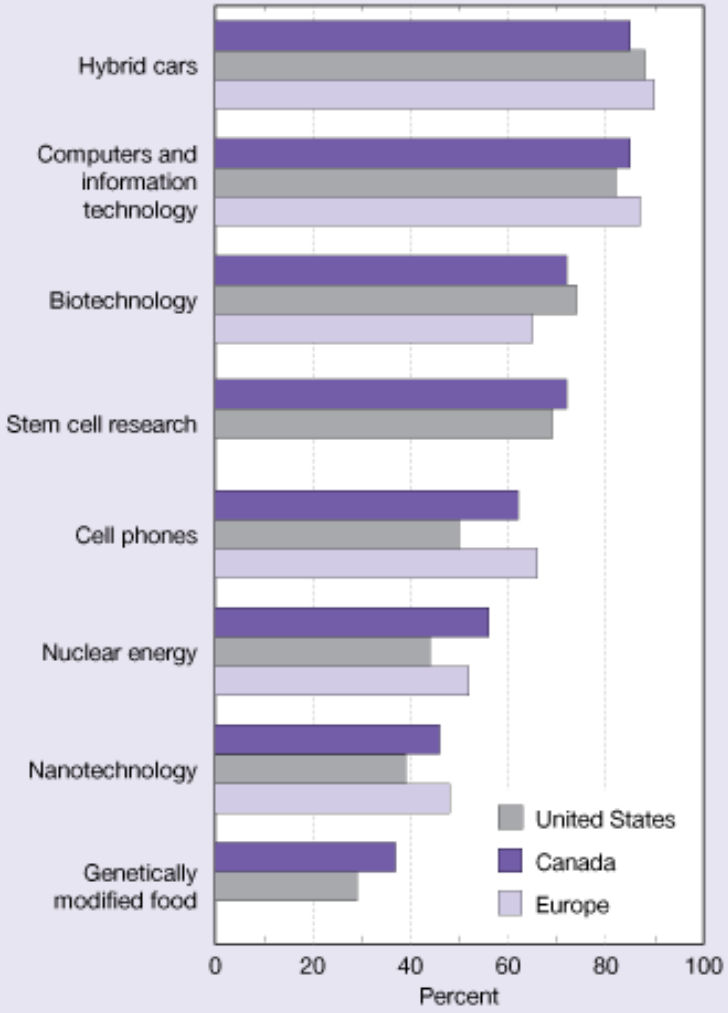
Modern Technology and the Ecological Threshold

- During the 20th century, the obvious benefits of technology—more food, increased speeds, greater heights in buildings and airplanes, mightier weapons—encouraged the adoption of the styles and technologies of tomorrow
- The darker side of technology, however, was long ignored. Modern technologies were becoming so elusive that any hurtful consequences were hard to associate with their unnoticed operations.
- Technological optimism in Western countries withstood the shocks of two world wars and one severe economic crisis, but the accumulation of negative associations led to increasing suspicion after 1960

Suspicion?

- In this 2005 survey, there are clearly doubts about technologies thought to affect the environment (GMOs, nuclear energy)
- A technology presented as beneficial (hybrid cars) gets high marks, however
- In between, medical and communication technologies with unclear environmental consequences but personal benefits are rated quite highly

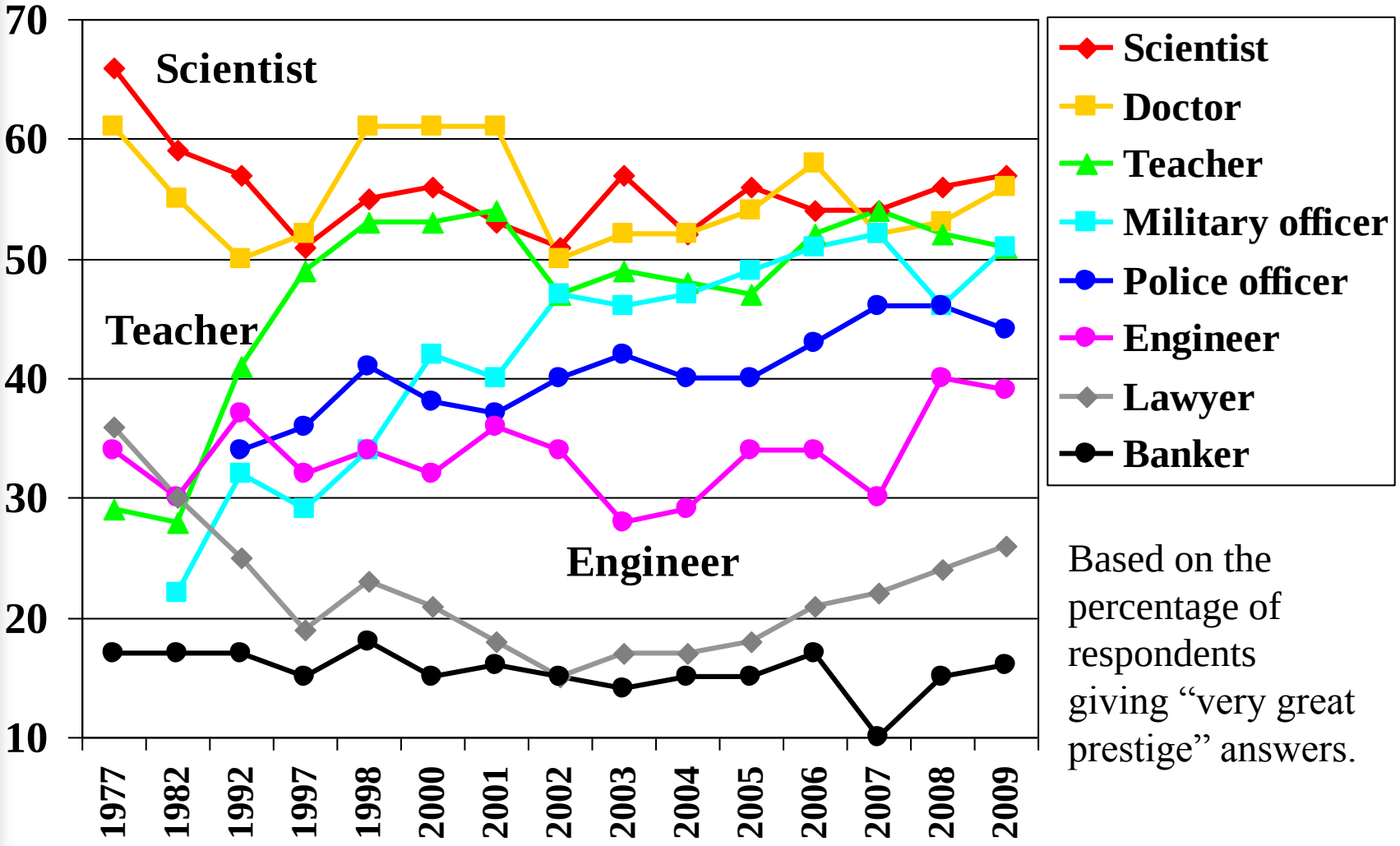
Impact of new technologies in United States, Canada, and Europe: 2005



NOTES: Responses to: *I am going to read you a list of areas in which new technologies are currently developing. For each of these areas, do you think it will improve our way of life in the next twenty years, it will have no effect, or it will make things worse?* (In Europe, the question was worded: *For each of these, do you think it will have a positive, a negative, or no effect on our way of life in the next 20 years?*) Data are percent of responders who believe things will improve or have a positive effect.

SOURCE: Canadian Biotechnology Secretariat, Canada-U.S. Survey on Biotechnology (2005); and European Commission, Research Directorate-General, Eurobarometer 224/Wave 63.1: *Social Values, Science and Technology* (2005).

Occupational prestige in the U.S.

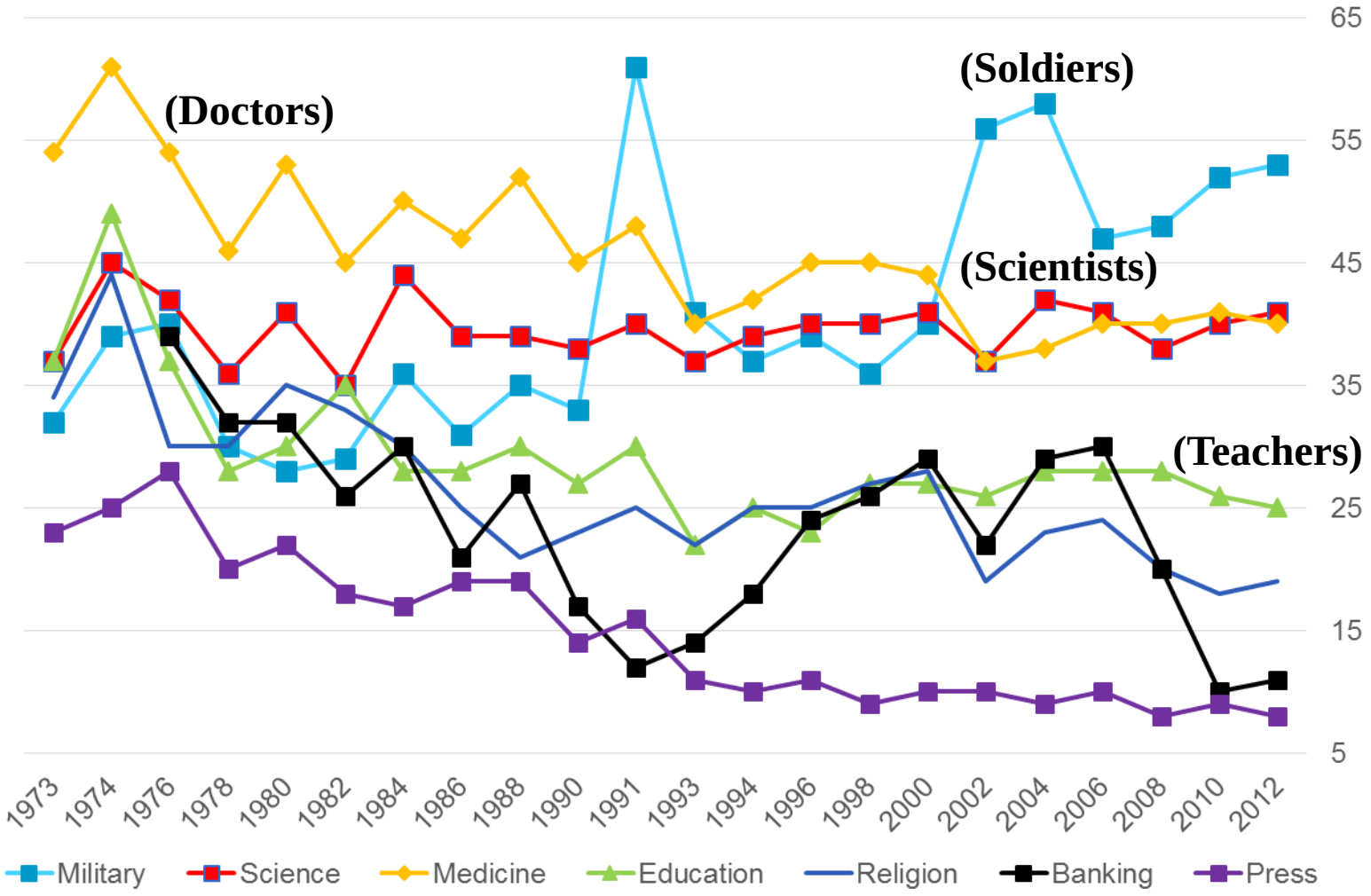


Based on the percentage of respondents giving "very great prestige" answers.

Question: [do] you feel [this occupation] is an occupation of very great prestige, considerable prestige, some prestige, or hardly any prestige at all?

Science and Engineering Indicators, 2010; *The Harris Poll*, 2009

Institutional confidence in the U.S.



Question: As far as the people running these institutions are concerned, would you say that you have a great deal of confidence, only some confidence, or hardly any confidence at all in them? (Percentage answering "great deal of confidence")

Before the War: Americans in Europe… (1910)

John Singer Sargent, *Breakfast in the Loggia* (1910): Lady Richmond and American painter Jane de Glehn enjoy breakfast at the Villa Torre Galli near Florence, Italy

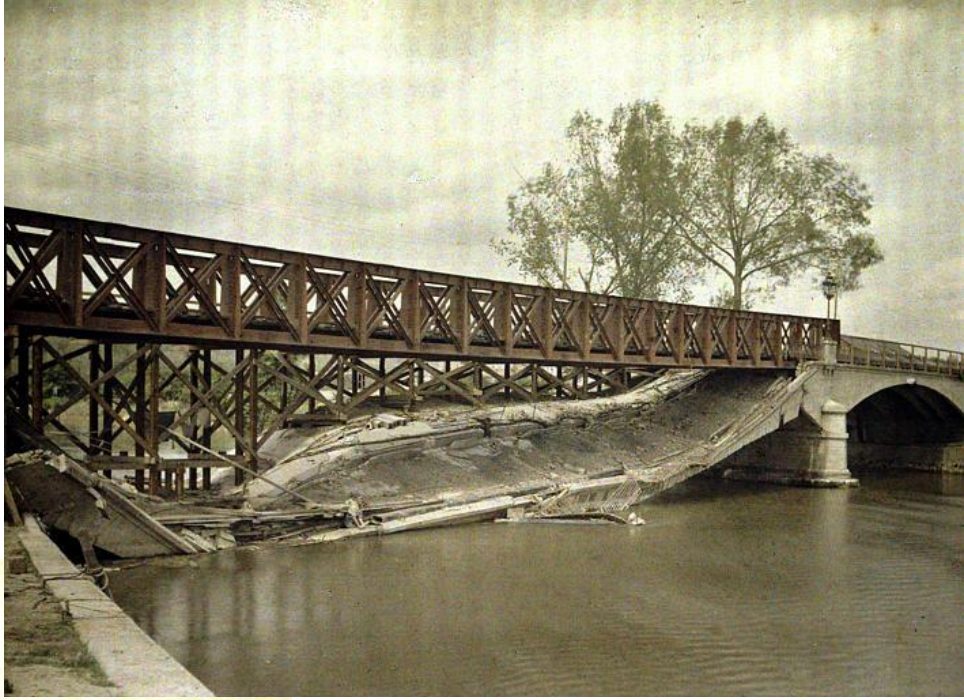
The New Destructiveness of War

Autochrome (colour) picture of the Front in 1916

Bombed buildings in Rosendael (France) in September 1917

The front lines in 1917 near Passchendaele, Belgium, north of Ypres

Fallen Bridges…



↓ Fallen truss bridge in Noyon, 1917

Autochrome picture by Fernand Cuville, with some discoloration

↑ This fallen stone bridge in the Aisne region has been replaced in part by an emergency bridge put up by army engineers (1917).

Autochrome picture by Fernand Cuville

Train yards and orchards…

← Train yard in Soissons, destroyed in 1917.
Autochrome picture by Fernand Cuville

Fruit tree allegedly cut down →
by the retreating Germans in 1917 in the Aisne region.
Autochrome picture by Fernand Cuville

Devastated Cities

← Storefront in Reims, 1917, after the French city's pounding by artillery

Autochrome picture by Paul Castelnau

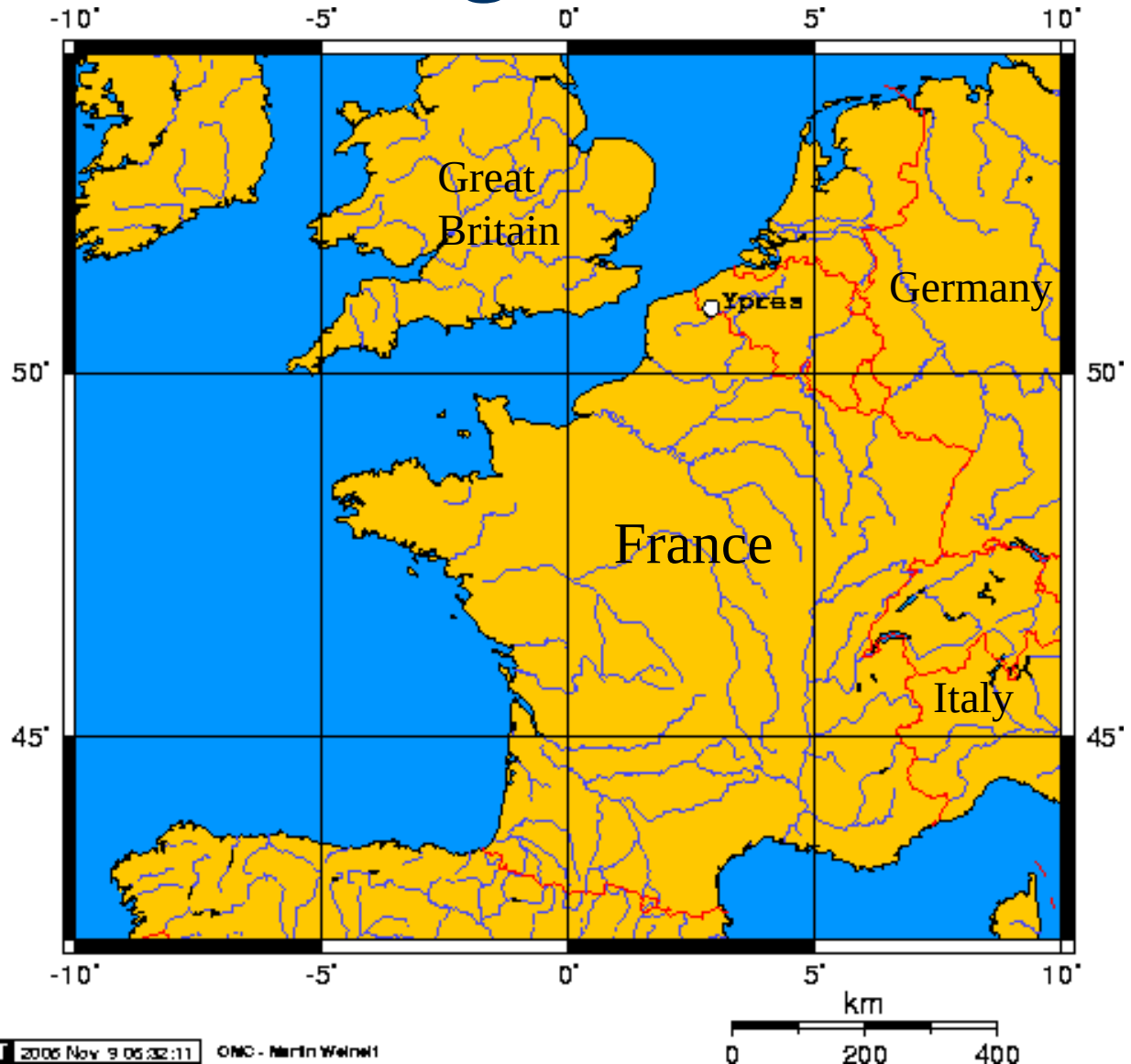
Panorama of Reims in 1917 →

Autochrome picture by Fernand Cuville

The Ypres Salient (Belgium, WWI)

The city of Ypres, battered by artillery

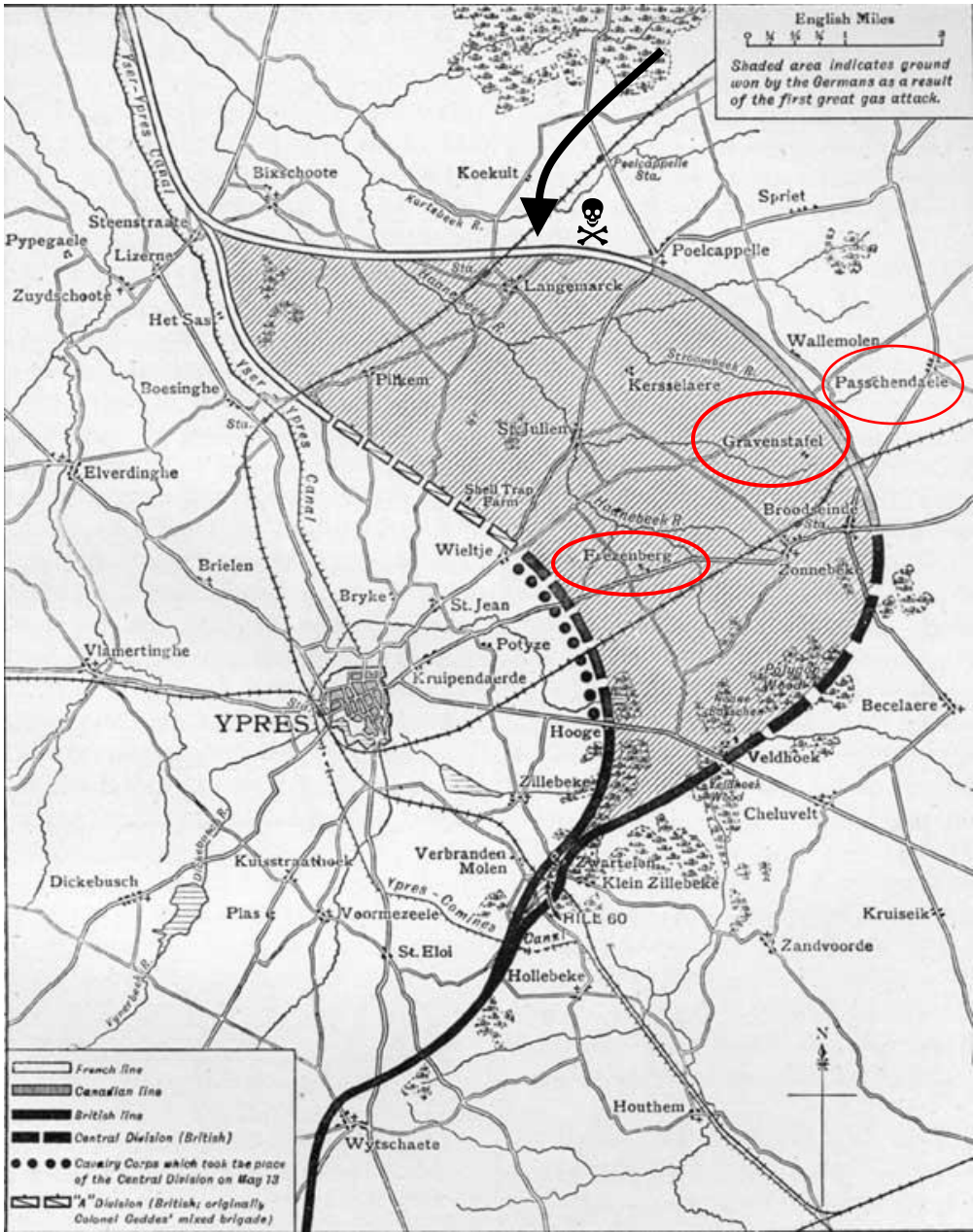
Ypres (or Ieper) was a key foothold in Belgium for the Allies



Second Battle of Ypres (1915)

The Beginning...

- 22 April 1915: The first attack starts with the release of billows of a greenish-yellow gas pushed by the wind toward the Allied positions—trenches mostly held by French troops
- The gas is chlorine and quite effective; the French troops break, opening up a large gap on the left of the Canadians
- 24-25 April 1915: The Canadians are subjected to a chlorine gas attack and hold the Gravenstafel ridge
- In May, the Princess Patricia's Canadian Light Infantry hold off an attack on Frezenberg and Bellewaerde ridges; the battle winds down as the Allies retreat



Poison gas: Evolution and Adaptation

Though the French had experimented first with the use of tear gas in battle during World War I, the German attacks at Ypres in 1915 marked the first major use of a lethal gas. Chlorine soon gave way to new compounds: phosgene and mustard gas. Both sides used them and adapted, developing new shells for delivery and gas masks for protection.

British soldier with early gas mask

U.S. soldier and horse with gas masks ➔

U.S. Marines with later gas masks

Everyday Life in a Chemical War

A gas mask drill or demonstration at the front

Canadian soldiers buying fruit and other goods from young French girls. The girls are said to be carrying gas masks, presumably in the form of the cloth bags slung over their shoulders.

Gas Masks For All (*c.* 1916)

This picture was taken at the Canadian Army Veterinary Corps Headquarters in Shorncliffe (UK)

Library and Archives Canada, PA-005001

A "Scientific" Weapon

- As a weapon, chlorine proved unsatisfactory: it was visible, easily smelled, and only fatal in high doses
- Phosgene replaced it as a killing gas. It had a faint odor like that of decaying hay, did not irritate the skin and only irritated the eyes a bit, so that men were gassed before they knew it. Inhalation caused severe edema of the lung and it killed by asphyxiation in a few hours
- In 1917, dichlorethylsulphide ("*ypérite*" to the French, "mustard gas" to the British) was introduced: impossible to smell in its pure form, it penetrated clothing and its effect (ulceration of the skin, the eyes, the lungs) only became obvious hours after exposure

Gases used by Germany and its allies: "Acrolein, allylisothiocyanate, arsenic trichloride, arsine, bromacetone, bromacetic ether, bromethylmethylketone, bromide of benzyl, bromide of xylyl, bromide of toluyl, bromine, carbon monoxide, carbonyl chloride (phosgene), chloracetone, chlorine, chloropicrin, cyanogen, dichlorethylsulphide (mustard gas), dichlormethylether, dimethylsulphate, diphenylchlorarsine, diphenylfluorarsine, ethyldichlorarsine, formaldehyde, hydrocyanic acid, hydrosulphuric acid, iodacetic ether, iodacetone, methylchlorsulphonic acid, monochlormethylchloroformate (palite), nitrogen peroxide, phenylcarbylamine chloride, phosphine, phosphorus trichloride, sulphur dioxide, sulphur trioxides and trichlormethylchloroformate (diphosgene or superpalite)". Great Britain and its allies also used lethal and non-lethal gases.

The Terror of the New (1)

- Statistically, gas was not a decisive weapon; it accounted for roughly 90,000 combat fatalities and another 1.2 million non-fatal casualties, which is about 3% of the total numbers; by war's end, however, mustard gas was producing 14% of all casualties on the battlefields where it was used
- Yet, gas inspired inordinate fear, perhaps for its insidious action and drawn-out deaths
- Mustard gas could persist in the soil for up to 3 years; it attacked the eyes and the softer, thinner skin (around the face and genitals)

Medical Care for the Gassed

- Remove clothing and disinfect it
- Wash skin with warm soapy water and bicarbonated water
- Wash eyes with 22.5% bicarbonated water; use a tablespoon of sodium bicarbonate, 2-3 times a day
- Wash eyes with 22.5% bicarbonated water and sodium permanganate (1 part in 4000) in 7‰ saline
- For tears and photo-phobia: 1% atropine
- For pain: 0.5% cocaine
- For suppuration: 2% colloidal silver
- Erythema: talcum powder
- Phlyctena: gomenol oil; open aseptically
- Infection: gomenol or ichtyol paste; apply Alibour's water

Wounded Canadian soldiers being evacuated in September 1916 (France)

William Ivor Castle, Library and Archives Canada, PA-000912

The Terror of the New (2)

- Doctors were often able to do little; a British nurse wrote about mustard gas casualties:

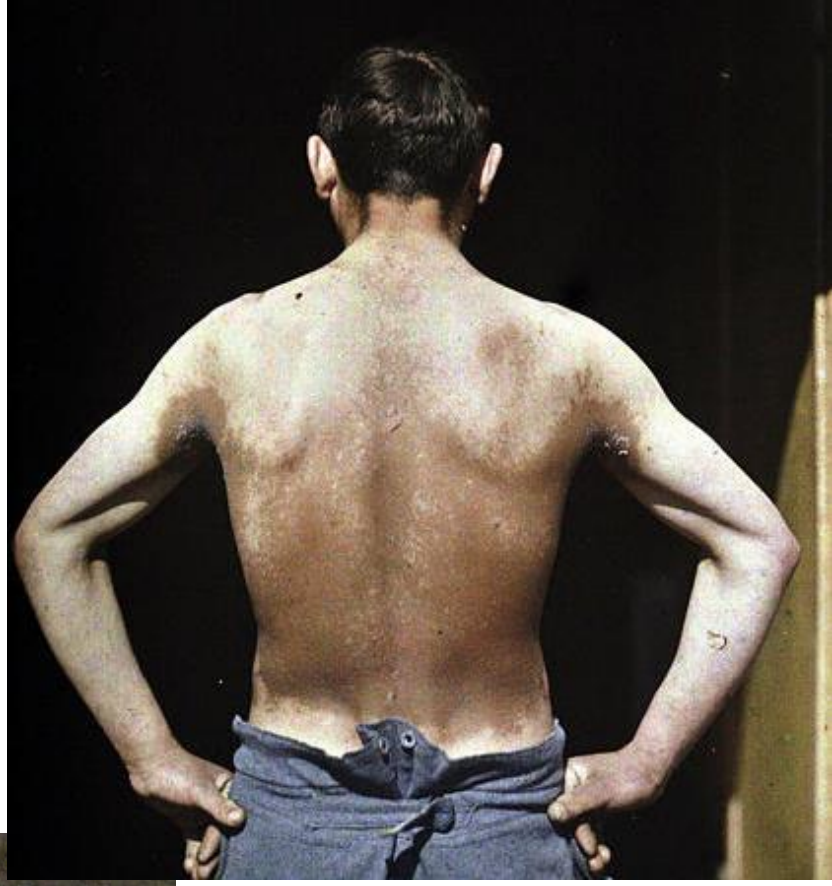
"They cannot be bandaged or touched. We cover them with propped-up sheets. Gas burns must be agonizing because usually the other cases do not complain even with the worst wounds but gas cases are invariably beyond endurance and they cannot help crying out."

- Survivors were often scarred for life; lung damage exposed them to a higher risk of tuberculosis; many died within 20 years
- Terror of gas combined with claims for its mass destruction potential to produce a ban on their use after the war

Allied gas victims

This French soldier of the 99th Infantry Regiment was gassed on March 23rd, 1918. He survived, though gas burns cover his lower back and extend under his armpits. ➔

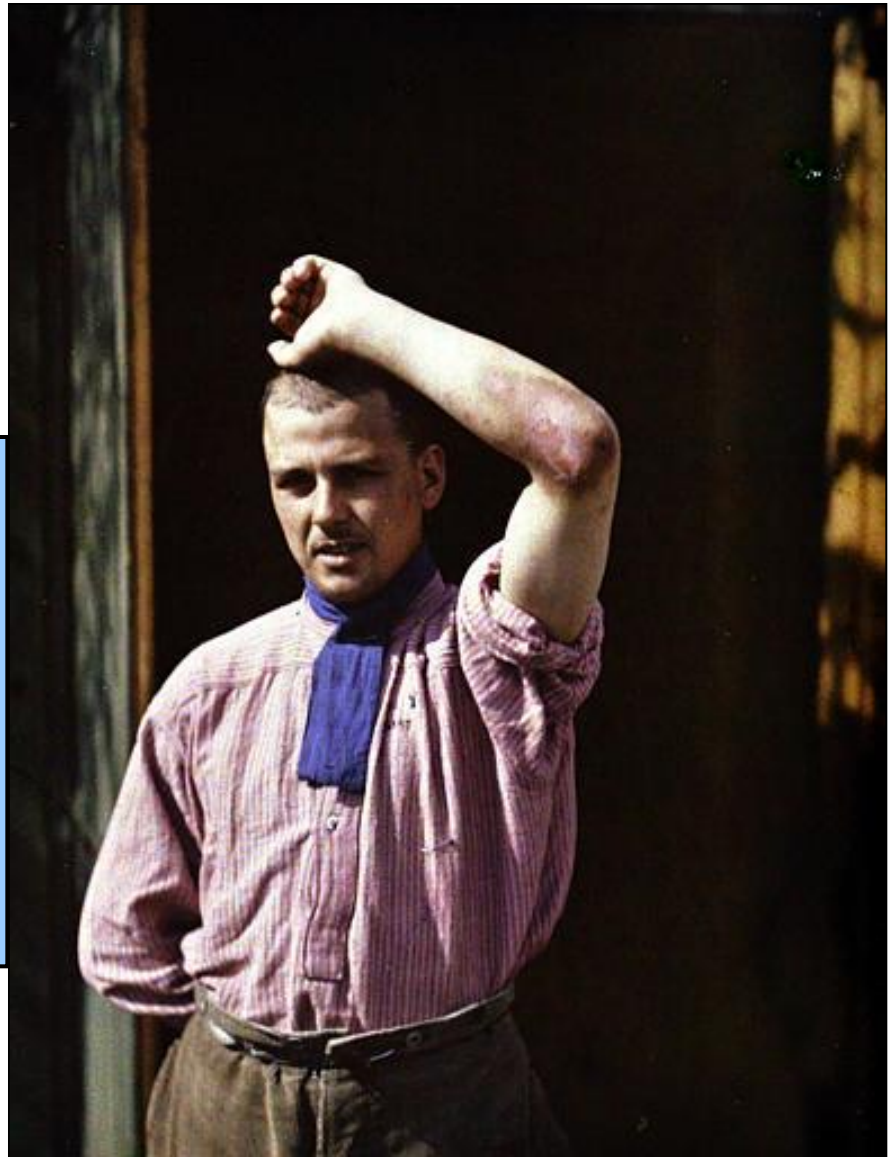
Autochrome picture by L. Aubert



➔ This soldier of the same regiment, gassed on the same day, did not survive.

Autochrome picture by L. Aubert

Autochrome pictures of gas victims



Medical picture of a French soldier of the 99th Infantry Regiment, gassed on March 23rd, 1918.
Autochrome picture by L. Aubert

Medical picture of a French soldier of the 22nd Infantry Regiment, gassed on March 18th, 1918. The mustard gas penetrated his clothing, causing widespread blistering and suppuration.
Autochrome picture by L. Aubert

And a future German gas victim…

Adolf Hitler (1889-1945), seen here on the far right with his dog Fuchsl *circa* 1916 or 1917, carried urgent dispatches at Passchendaele in August 1917. In October 1918, still fighting near Ypres, he is gassed during a British shelling and temporarily blinded.

Better Dying Through Chemistry*

Soldiers blinded by gas march slowly to the rear of the lines, holding each other.

Mustard gas victim

* After World War I, the munitions manufacturer DuPont de Nemours was accused of war profiteering. To spruce up its image, it hired an ad firm (BBDO) that came up with the slogan “Better Things for Better Living… Through Chemistry”

At the End of the War: Americans in Europe… (1918)

Imperial War Museum, London

The United States joined World War I on the side of France and the British Empire in 1917. Painter John Singer Sargent, who had known Europe before the war, now left no doubt as to what would be remembered of the Great War. This famous painting, its yellow tint perhaps meant to recall the early use of chlorine, has a one-word title: "Gassed"

What price (Canadian) glory?

- Of the Canadian survivors of the Ypres chlorine attacks, 60% had to be repatriated and half were still unfit for duty at war's end, three years later
- Per capita, Canada paid a heavy toll, much heavier than the U.S.

German gun captured at the battle of Vimy in 1917 by Canadian troops and now preserved in Quebec City.

The Cost of Mass Warfare: WWI

	Troops mobilized	Killed	Wounded	POW/MIA	Died as POW or from disease	Total	% of all troops
Russia	12,000,000	1,700,000	4,950,000	2,500,000	N/A	9,150,000	76.3%
France	8,410,000	1,357,800	4,266,000	537,000	297,000	6,160,800	73.3%
British Empire	8,904,467	908,371	2,090,212	191,652	N/A	3,190,235	35.8%
(Australia)	331,000	61,000	159,171	N/A	N/A	220,171	66.7%
(Canada)	626,000	66,655	174,000	2,818	N/A	243,473	38.9%
U.S.A.	4,734,991	53,402	204,002	3,700	63,114	324,218	6.8%
Japan	800,000	301	907	3	0	1,211	0.2%
Germany	11,000,000	1,773,300	4,216,058	1,152,800	224,000	7,142,558	64.9%
Austria-Hungary	7,800,000	1,200,000	3,620,000	2,200,000	32,000	7,020,000	90.4%
Turkey	2,850,000	325,789	400,000	250,000	163,000	975,789	34.2%

Shaded totals are subsets of preceding column. WWI statistics vary enormously; these numbers are purely indicative.

To recapitulate (1)

- What was the first lethal gas used in combat?
- How many countries had over a million men killed in combat during WWI?
- What gas became infamous for producing temporary blindness in soldiers exposed to it?
- What future German leader was a gas victim during WWI?
- Did (unprotected) victims of a gas attack enjoy stronger and improved lung function afterwards?
- Has the occupational prestige of engineers always been higher than that of lawyers since 1977 in the U.S.?

The Wartime Transformation of Mobility (if not speed…)

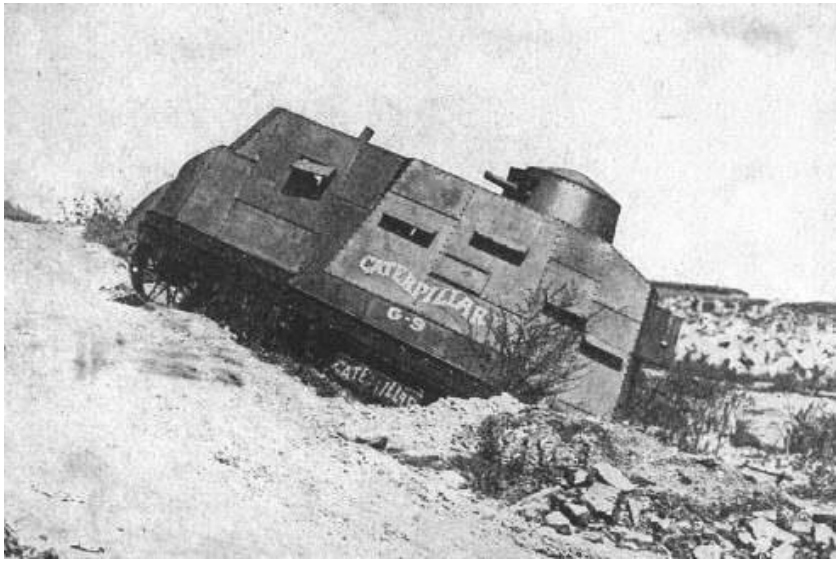
- All the armies engaged in 1914 still had cavalry units at the outset of the war
- However, the battlefield was equally transformed by new technologies of mobility. In the 1914 battle of the Marne, some troops were shuttled by Parisian motorcabs, but bicycles and motorcycles also served along the front
- By 1918, motorized transportation ruled, and tanks had gone into battle

The Early Evolution of Armour

British tank prototype
(clearly a “tank”)

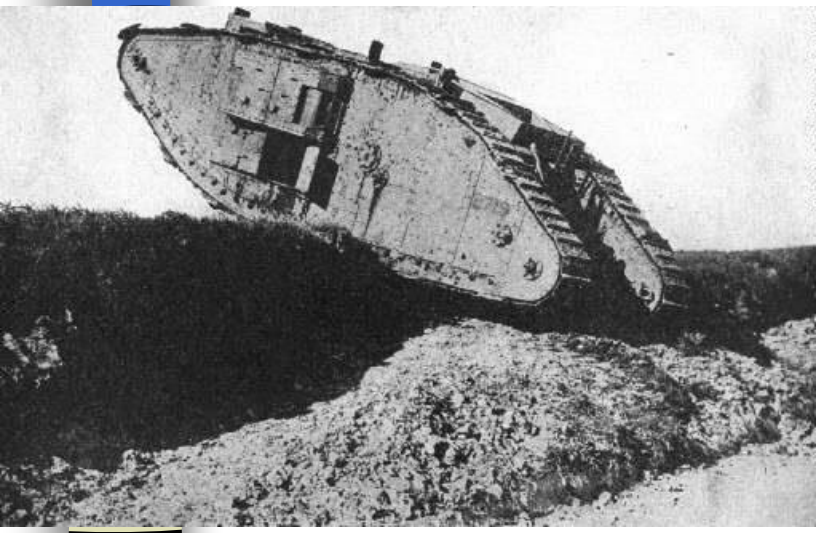
A French tank
made by Renault

A U.S. steam-powered tank

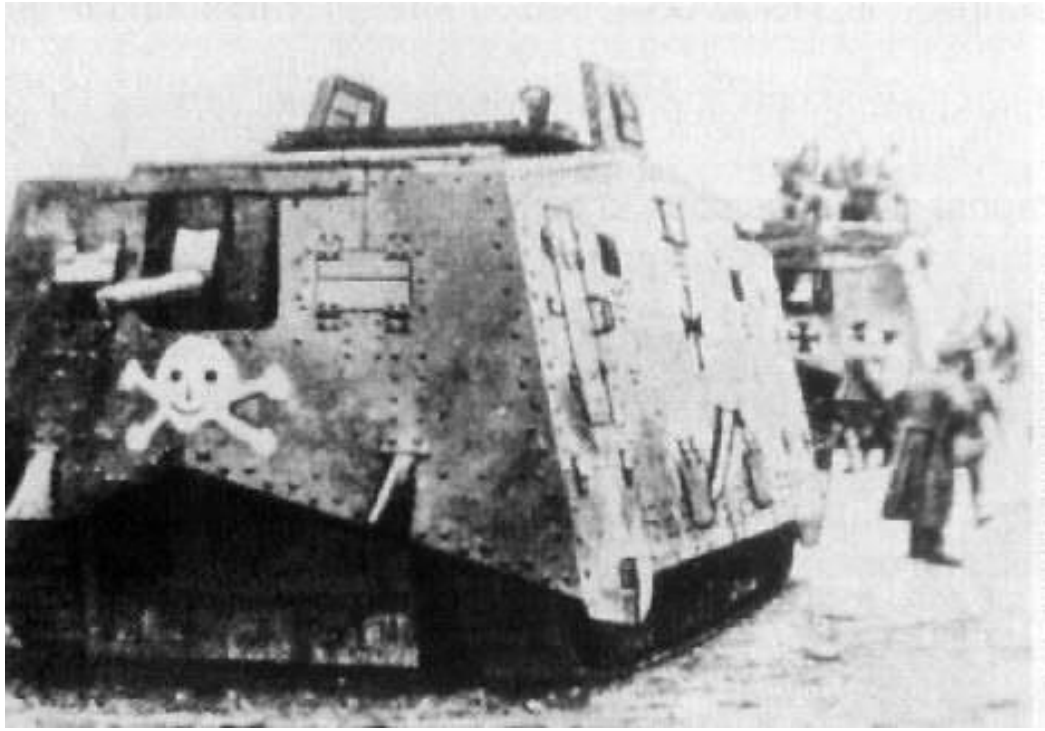


A U.S. tank made by Caterpillar

The Later Evolution of Armour



British tank crossing a trench



German A7V tank ↗

Canadian troops manning armoured cars

Technology between the wars

- Technological advances during the “Roaring Twenties” contributed to the good life for many North Americans: greater electrification, the mass production of motor cars, refrigeration, the spread of radio, the beginnings of air travel, the rise of synthetics (cellophane; rayon; DuPont’s Fabrikoid, marketed as artificial leather and used for convertible tops), and more
- At the same time, the fear of a new war fought with bombers equipped with poison gas bombs grew more intense as war with Nazi Germany loomed
- And the wreck of the *Hindenburg* in 1937, reported by radio and filmed for the news, brought home the risks of new technologies, just like the *Titanic*’s sinking in 1912
- Yet, the use of poison gas in World War II was not the expected one...

Wartime German Zeppelin

(U.S. postcard by the Brown Brothers, date unknown)

Lighter-than-air: the Zeppelin era

During World War I, the Germans had used small Zeppelins as bombers. After the peace treaties were signed, the British and the Americans attempted to build their own versions...

August 1, 1930: H.M. Airship R-100 at the mooring mast of the Saint-Hubert airport in Québec.

Canadian Government Motion Picture Bureau, Library and Archives Canada

And a British airship bound for Karachi…

The companion to the R100 was the R101, seen here in 1929 at the Royal Airship Works in Cardington, Bedfordshire

On its way to Karachi, it crashed in northern France in October 1930, killing 48 of its 54 passengers.

The U.S. navy airship *Shenandoah*, moored to aerial tender *Patoka* (July 1925)

- The U.S. Navy developed its own airships, finally building the *Akron* and the *Macon* as flying aircraft carriers capable of deploying up to five smaller airplanes for reconnaissance
- The *Akron* crashed and sank in a storm in 1933, killing 73
- The *Macon* crashed and sank in a storm in 1935, killing 2

U.S. National Archives
(ARC 520808)

Travelling in style above the clouds, until...

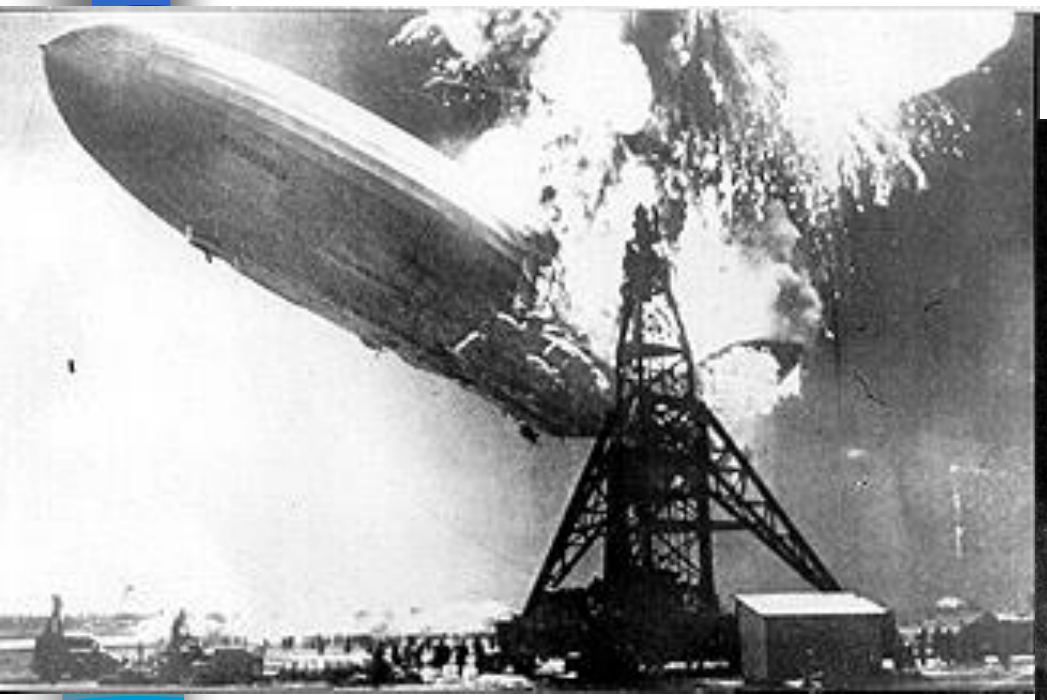
Lakehurst, New Jersey, USA

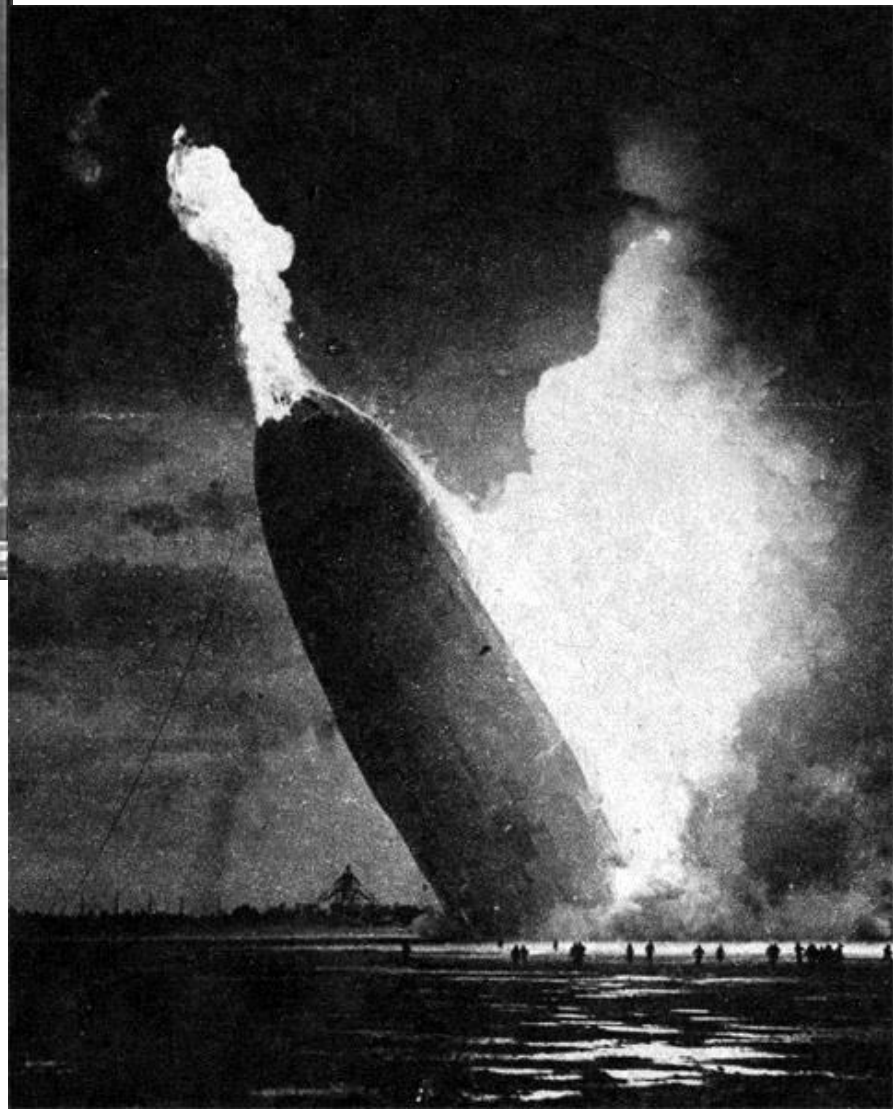
Even when the British and the Americans gave up on rigid airships, the Germans persevered.

And then the majestic *Hindenburg* caught fire in May 1937...

The *Hindenburg* Disaster (1937)

To this day, the *Hindenburg* remains the largest aircraft ever built.



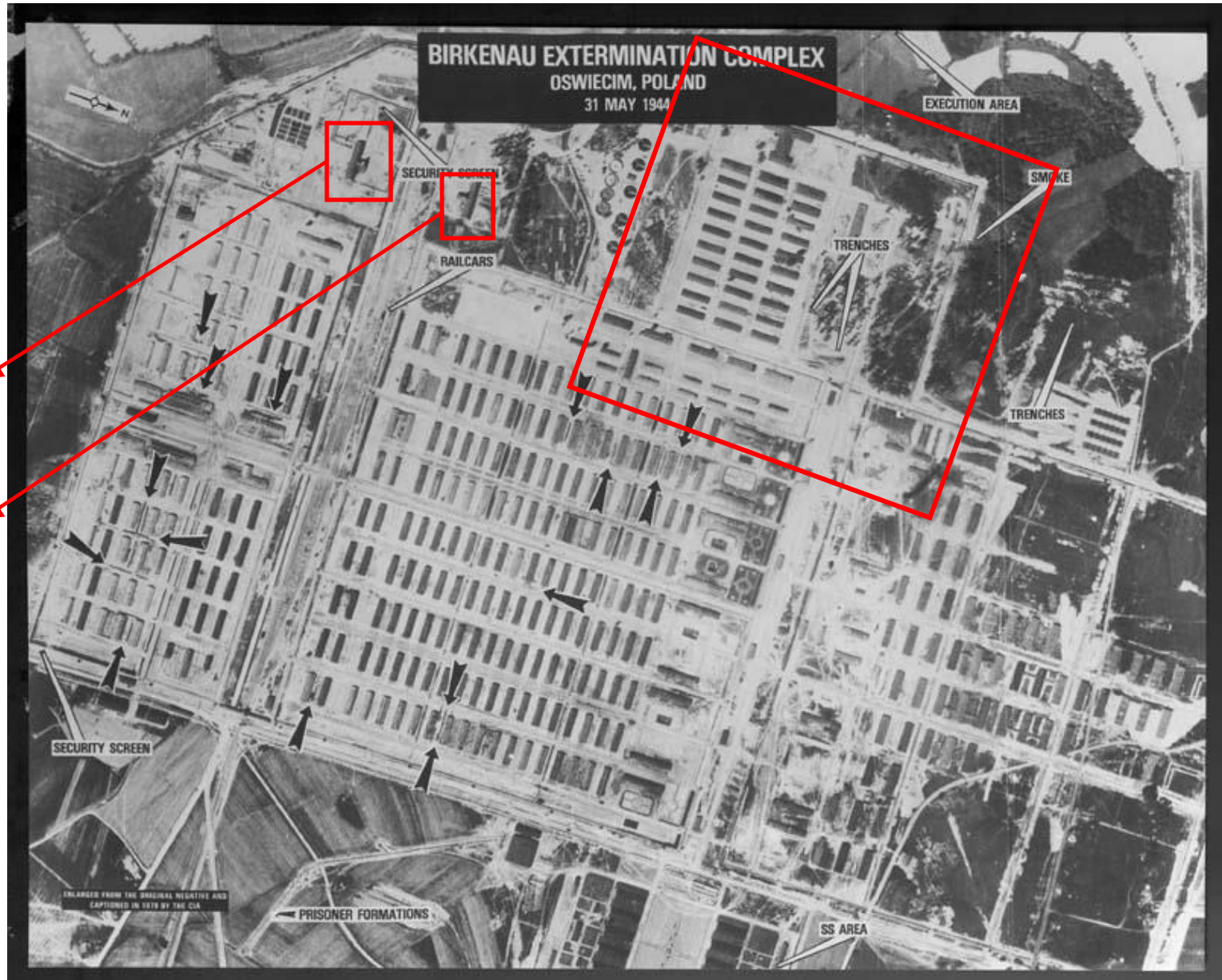


The German Zeppelin *Hindenburg* (LZ-129) was engulfed by fire in less than a minute at Lakehurst (New Jersey) on May 6, 1937. The fire and crash caused 36 fatalities.

Poison gas at Auschwitz-Birkenau

Crematorium II

Crematorium III



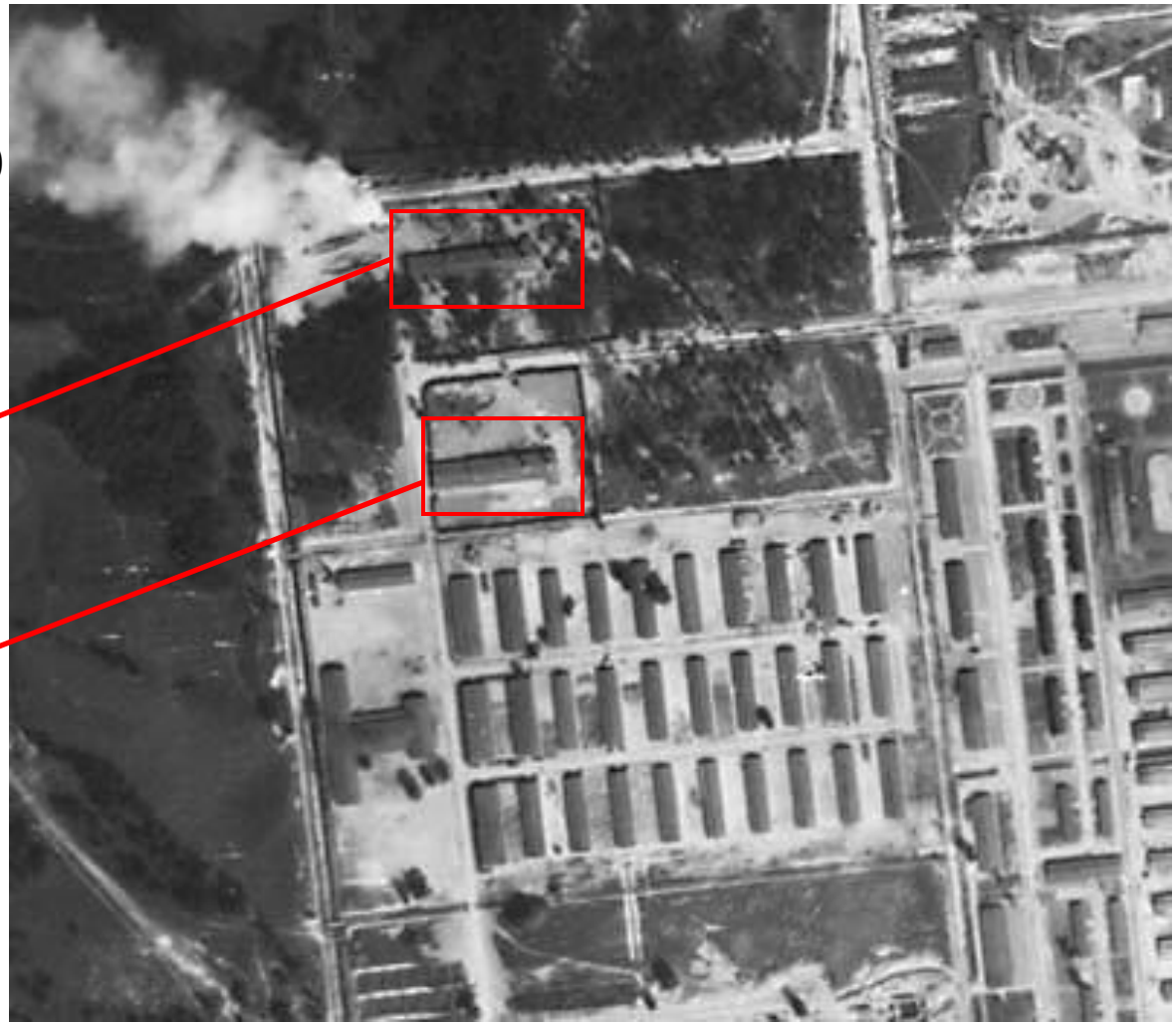
British Aerial Reconnaissance picture taken on August 23, 1944

Auschwitz-Birkenau extermination camp (smoke clearly visible)

Crematorium V

Crematorium IV

(destroyed by a prisoner uprising in October 1944)



From the Auschwitz Album: Jews disembark from cattle cars (May-June 1944)

From the Auschwitz Album: selection of the fit… and unfit (May-June 1944)

From the Auschwitz Album: the "unfit" (May-June 1944)

From the Auschwitz Album: walking to the gas chamber (May-June 1944)

From the Auschwitz Album: within the barbed wire (May-June 1944)

The BII sector of Auschwitz-Birkenau

Women and children walking through the BII sector on the way to the Crematoria

From the Auschwitz Album: Jews declared unfit, waiting to be sent to Crematorium IV (May-June 1944)

Crematoria V and VI

After the War...

- At Nuremberg, some of the accused Nazis claimed that they were merely following the lead of North American eugenicists
- Though discredited, eugenics would linger under other names
- The values of modernity (efficiency, planning, control, speed) and the claims of science were questioned
- Nevertheless, the war confirmed the power of the systematic coordination of interdisciplinary teams in the pursuit of well-defined goals, as was already practiced by the research laboratories of large companies

"yet in god's name let's have done with lies"

- In 1967, Canadian poet Irving Layton expressed a common anguish in a preface to *The Shattered Plinths*
- "I submit that a new element was ushered into the human situation with World War II, with the slave camps of Communist Russia and the extermination camps of Nazi Germany. With the terroristic bombings of Hamburg and Cologne. Hiroshima. Consider these: genocide, the systematic use of terror to cow entire regions into submission or surrender, mass extermination carried out with all the refinements a fiendish imagination could devise, the atrocities done to helpless victims for no other purpose but the gratification of sadistic impulse. […] The monstrous acts of National Socialism and National Bolshevism in the very heart of Europe are now to be apprehended not as causes of our moral degeneration but as symptoms […] Everywhere men are jumping off the fire-blackened roofs of Hamburg, Auschwitz, Hiroshima, and Treblinka, proclaiming violence against other humans a wholesome cleaning force and prepared to use their sensitized computers to tabulate the number of charred corpses, the number of radiated babies, the number of…"

To recapitulate (2)

- What new technology replaced the cavalry units of the armies fighting in WWI?
- Name one defence used by some Nazis on trial at Nuremberg after WWII to justify their mass killings of Jews and others?
- What German zeppelin crashed and burned in 1937, confirming the disadvantages of airships compared to planes?
- Were poison gases used during WWII? How?
- Name three (3) synthetic materials increasingly used between the two World Wars?
- What three (3) countries built airships between the two world wars?

Claiming the Future

- After WWI, out of the depths of the 1929 Depression, Modernist visions imagined a gleaming, streamlined future, fed by pre-WWI ideas put forward by urban planners, architects, writers like H. G. Wells, the Italian Futurists…
- After WWII, in spite of North American prosperity, the future was seen as potentially darker if it was given over to the "Machine" of economic and technological progress
- While it is sometimes argued that Fascism had sought a return to the past of easy categories and certainties, the debate has shifted to the nature of the specific future bought by humanity's best efforts

Fritz Jacob Haber (1868-1934)

- Designed with Robert Le Rossignol an ammonia synthesis process later perfected with and by Karl Bosch (1909-1913), crucial for manufacturing artificial fertilizers and explosives
- Pioneered the use of lethal poison gas (chlorine) at Ypres, and then proposed phosgene
- Supervised, after WWI, pest control research that produced Zyklon B

Haber is second from left in this picture of gas canisters at the front

In 1915, Haber's wife, Clara, a trained chemist, killed herself—in protest, some think, of his war work. In 1919, Haber received the 1918 Nobel Prize for Chemistry in recognition for his work on ammonia synthesis. In Allied countries, many scientists disagreed vehemently.

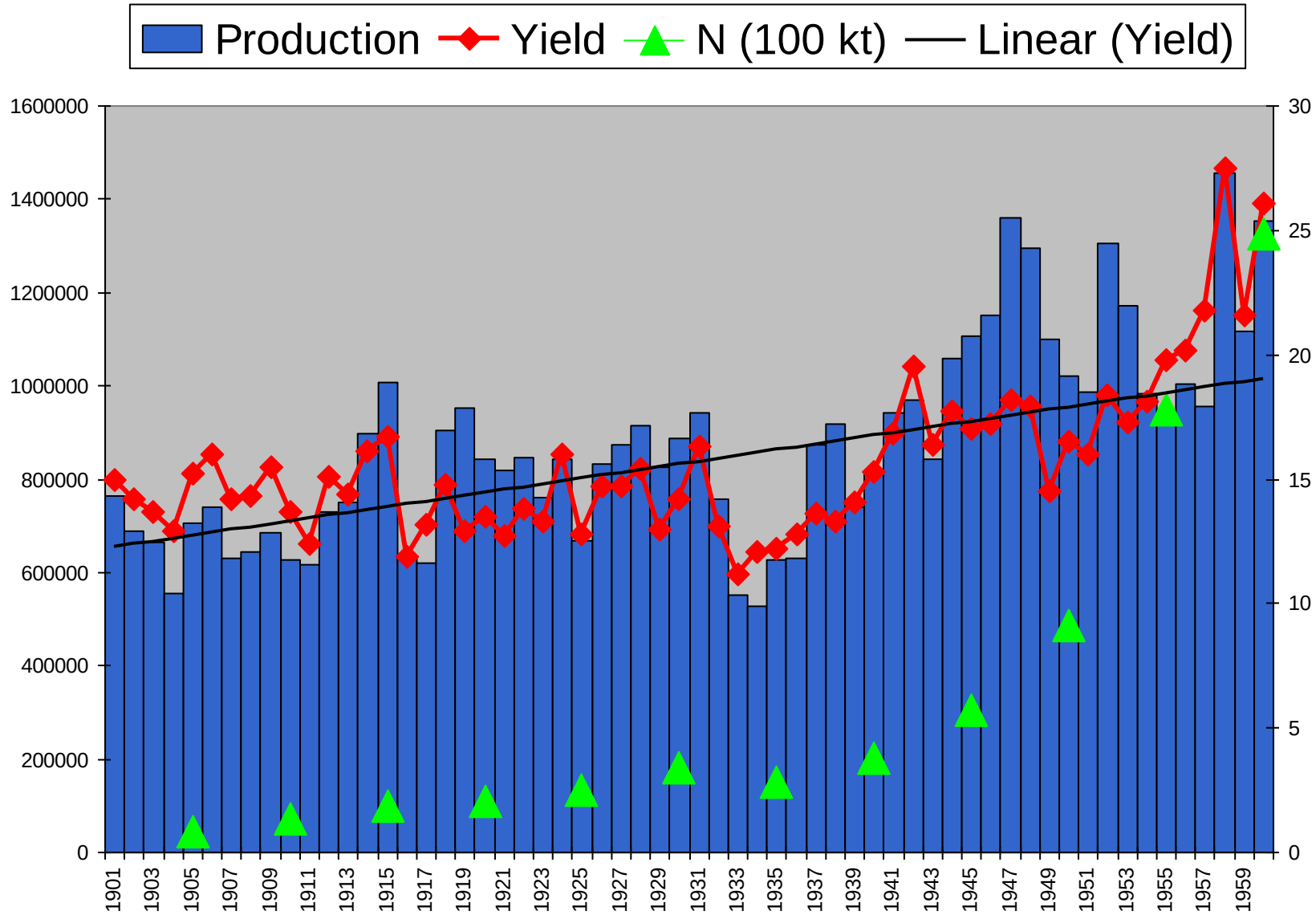
Wonders of modern chemistry

- Fertilizers
  - to provide essential elements to plants
  - ex.: phosphorus (phosphates)
  - ex.: nitrogen (ammonia, nitrates)
  - the post-WWI Haber-Bosch process made the synthesis of ammonia cheaper
  - Effects: “too much of a good thing”
- Pesticides
  - to fight pests that prey on crops (insects), compete with them (weeds) or plague them (fungi)
  - so: insecticides, herbicides, fungicides
  - post-WWII organic chemistry made pesticides more lethal
  - Effects: “poisoning the environment”

Nitrogen fertilizer consumption for all U.S. farming given in 100 kt/year.

Wheat Production in the U.S.

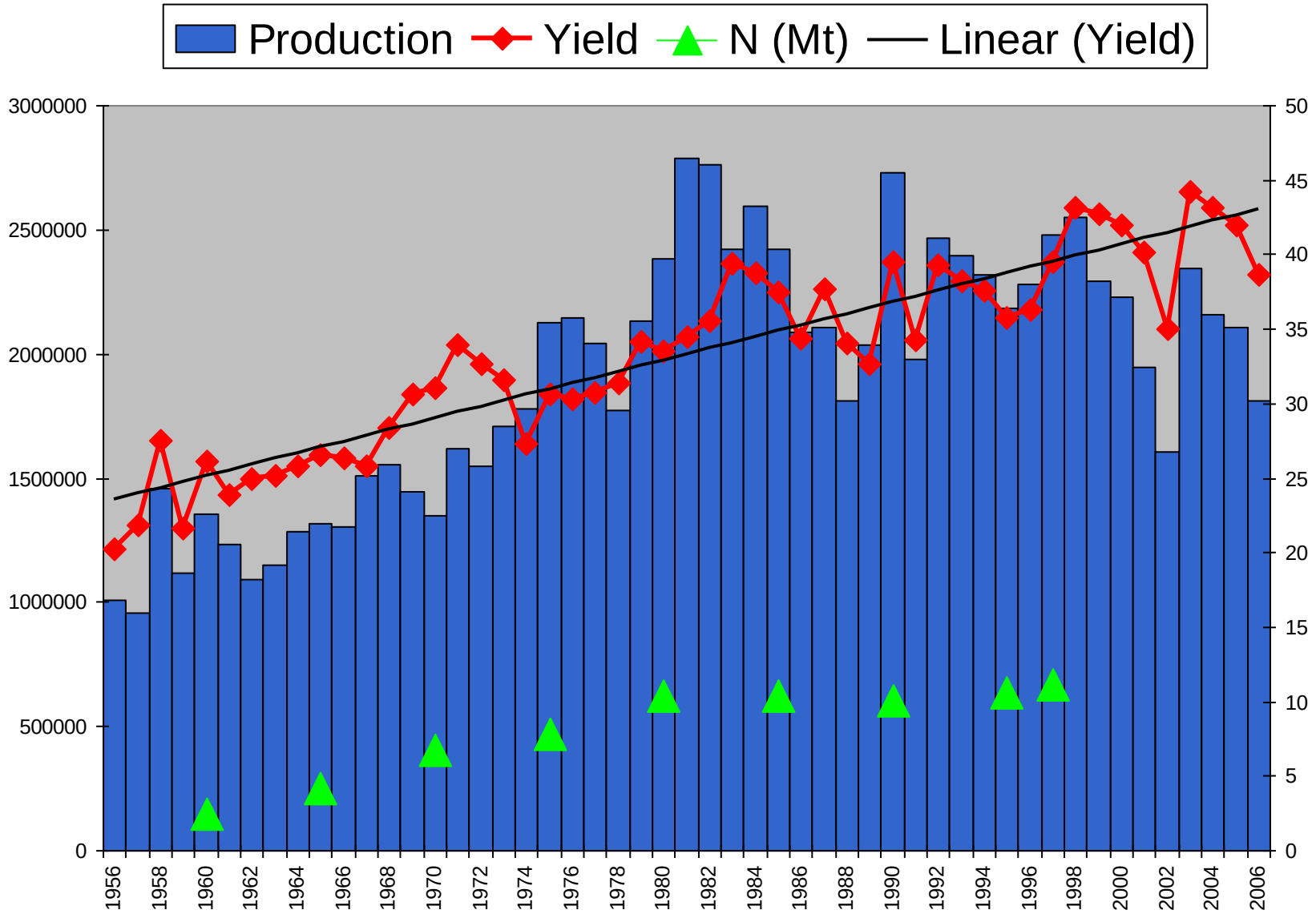
(all kinds, thousand of bushels, bushel/acre, 1901-1960)



Nitrogen fertilizer consumption for all U.S. farming given in Mt/year.

Wheat Production in the U.S.

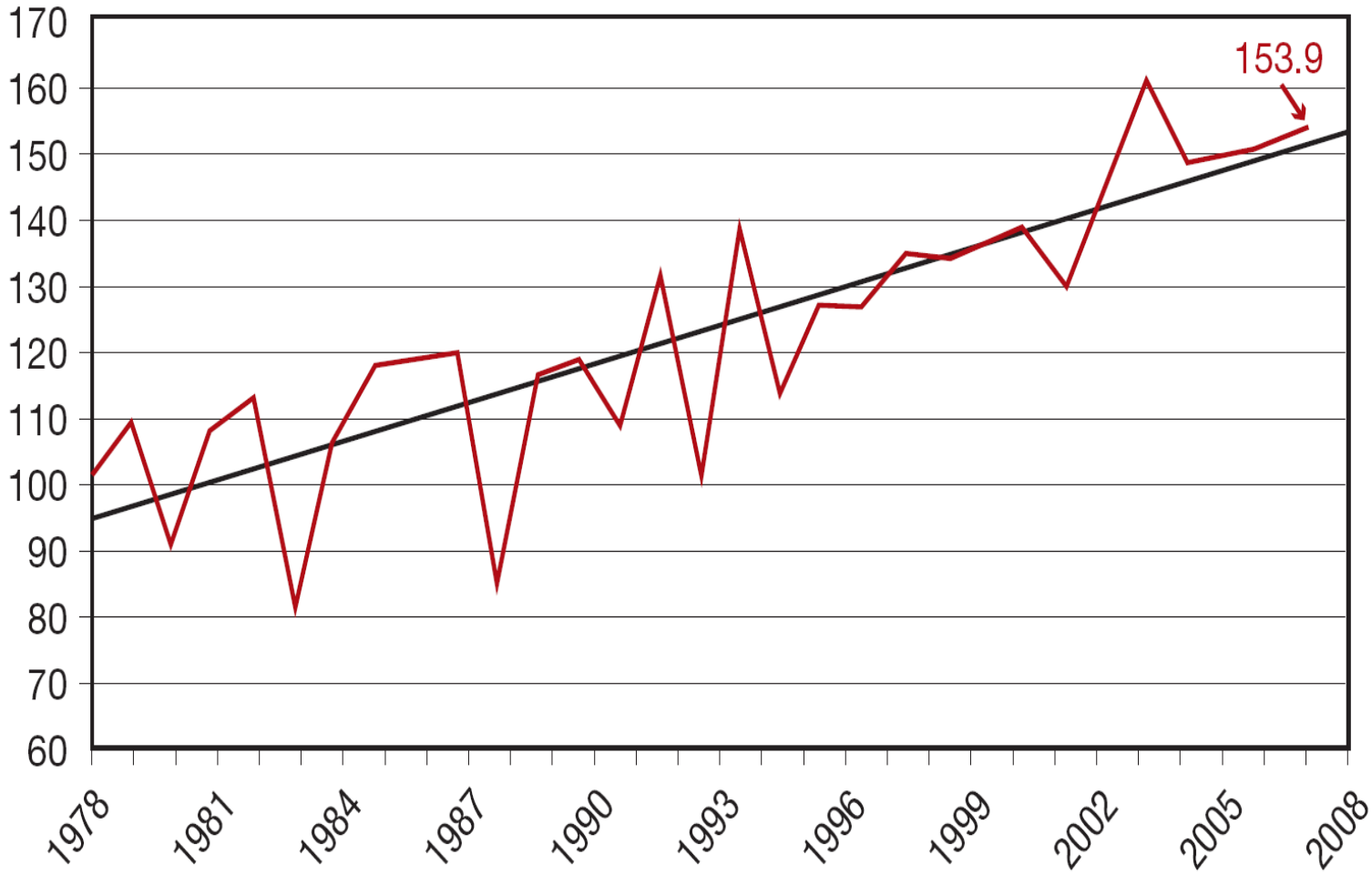
(all kinds, thousand of bushels, bushel/acre, 1956-2006)



Current corn yields are 6 times higher than in the 1930s. Plant breeding is thought to account for about half of the increase, the rest coming from better irrigation, fertilizer use, and improved mechanization

Corn Production in the U.S.

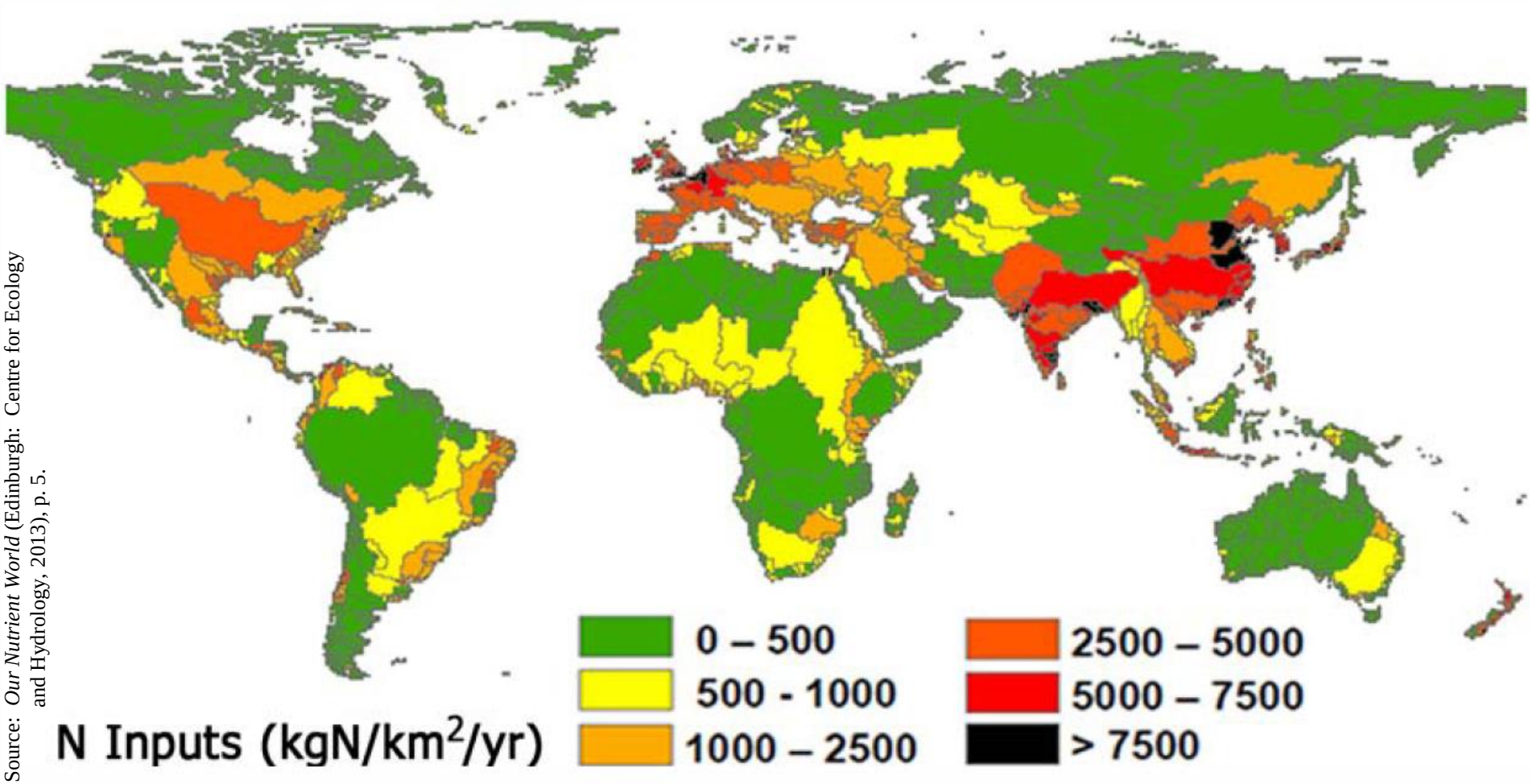
(all kinds, bushel/acre, 1978-2008)



Source: National Agricultural Statistics Service 2009.

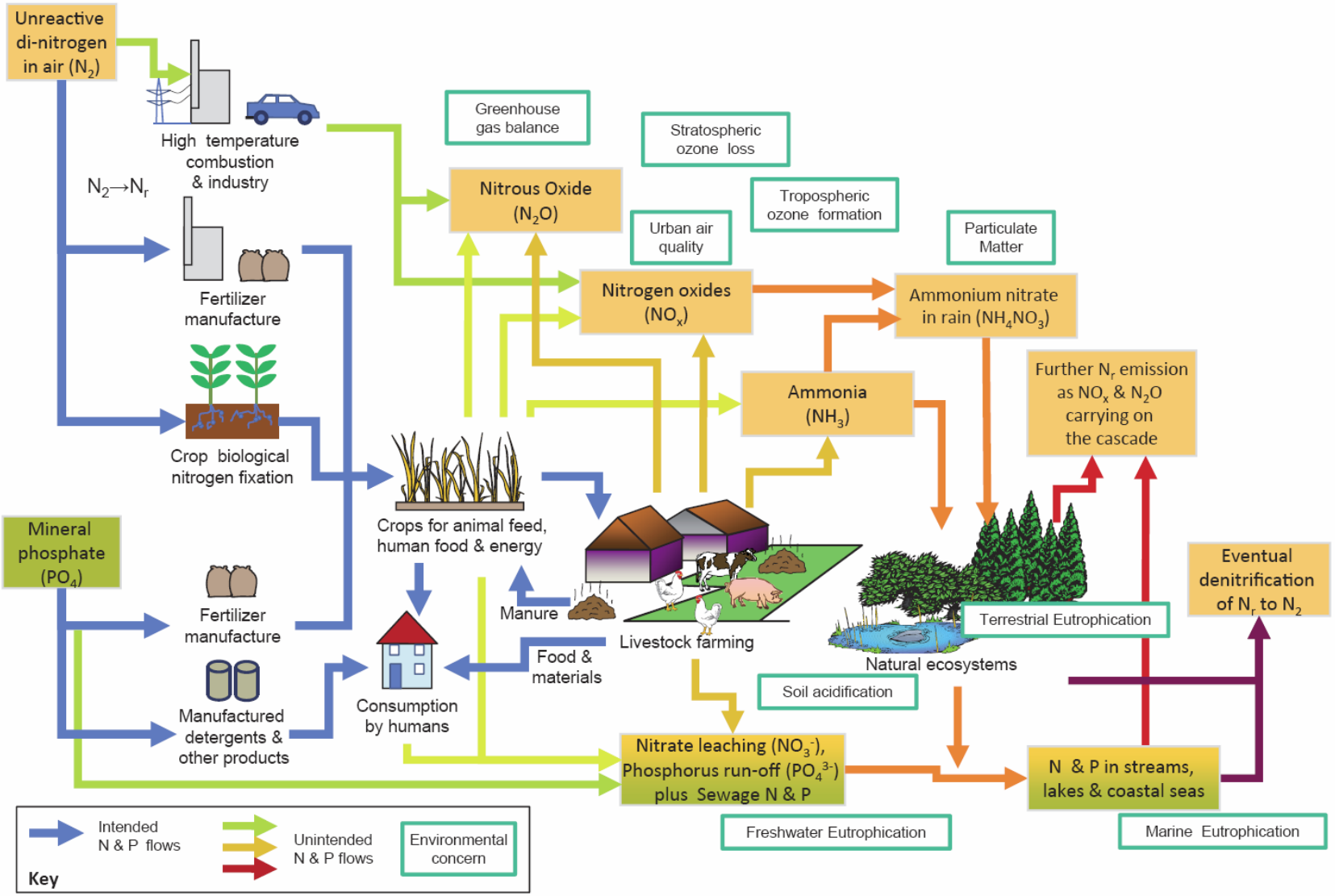
Source: Doug Gurian-Sherman, *Failure to Yield: Evaluating the Performance of Genetically Engineered Crops* (Cambridge: Union of Concerned Scientists, 2009).

Worldwide nitrogen inputs, from scarcity to excess



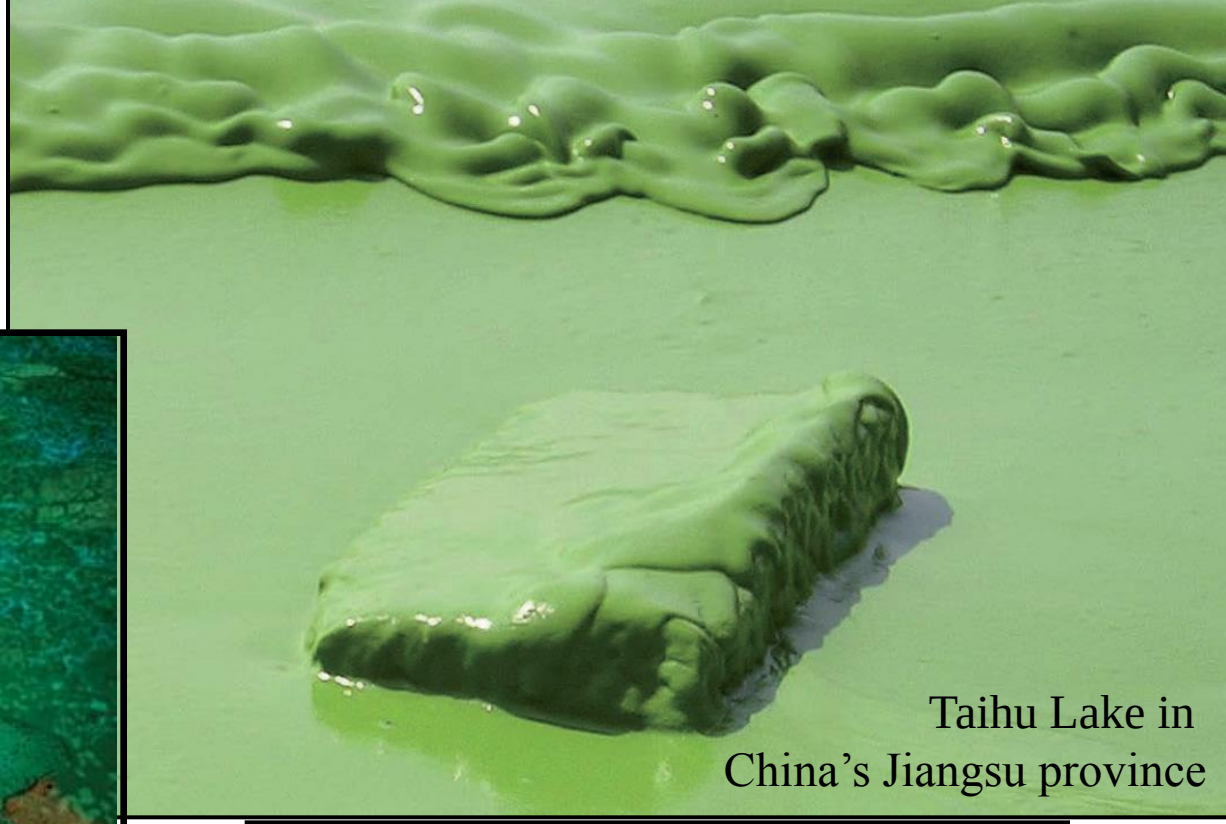
Source: *Our Nutrient World* (Edinburgh: Centre for Ecology and Hydrology, 2013), p. 5.

Schematic view of N and P flows



Source: *Our Nutrient World* (Edinburgh: Centre for Ecology and Hydrology, 2013), p. 5.

Algal blooms

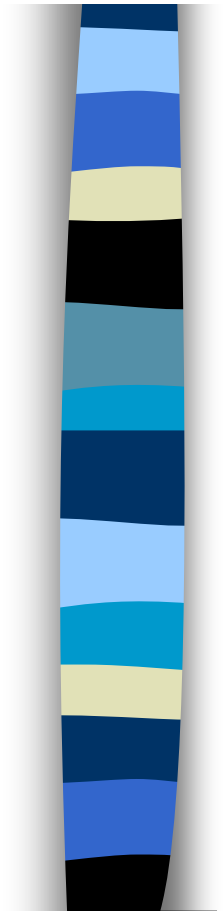


Taihu Lake in China's Jiangsu province

Excess nitrogen and phosphorus boost algal growth, but the decomposition of blooms sucks oxygen from water and may kill any fish present. In some cases, increased phytoplankton cell density gives rise to a "red tide".

Source: *Our Nutrient World* (Edinburgh: Centre for Ecology and Hydrology, 2013), p. 34, 91.

The gas chamber killer:
Zyklon B (HCN)



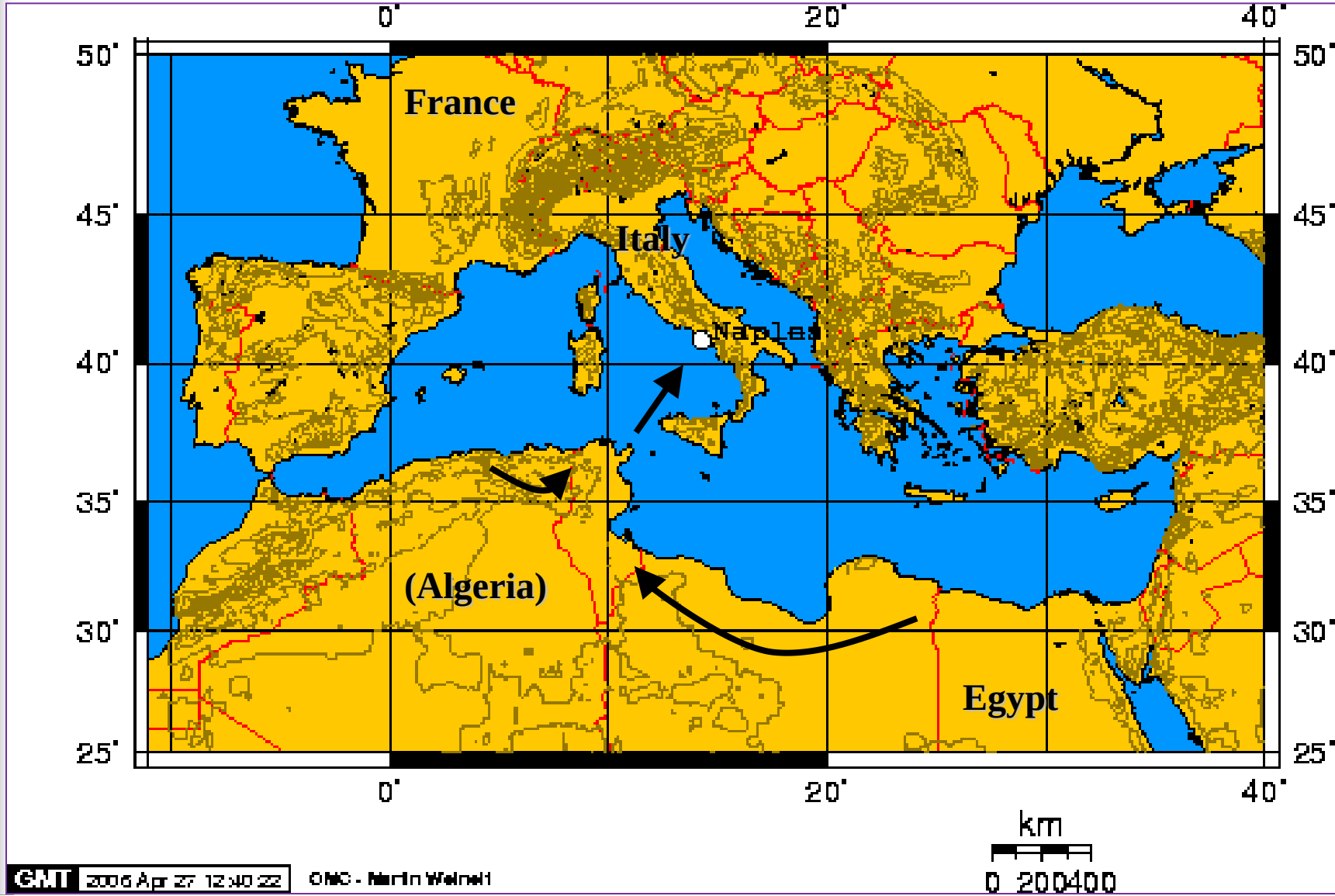
Typhus, the other killer...

- It is estimated that over 200,000 inmates of the Nazi camps died from typhus
- Typhus is caused by the *Rickettsia prowazekii* microbe, found in the feces of the human louse and passed to humans through puncture wounds
- Overcrowding, lack of sanitation, and poor food all favour the spread of typhus
- Thus, when typhus started appearing in Naples (Italy) by late 1943, after major outbreaks in the Middle East (3,000 dead in Egypt alone), the Allies had cause for worry

Typhus in Canada before WWII

For many immigrants, this was the first building they saw in Canada: the disinfection hall on Grosse- Île Island in the St. Lawrence. By 1927, doctors had a specific procedure for killing the lice responsible for typhus: after the disinfecting baths, “we rub on every hairy part of the body the following solution: for delousing: Hot water, 1 gall.; Gazoline 1 pint; coal oil 1 pint; soft soap 2 lbs. that we let dry on, we also sprinkle this solution on boots or shoes and leather bands on hats, etc., and on wigs.”

WWII: The Situation in 1943



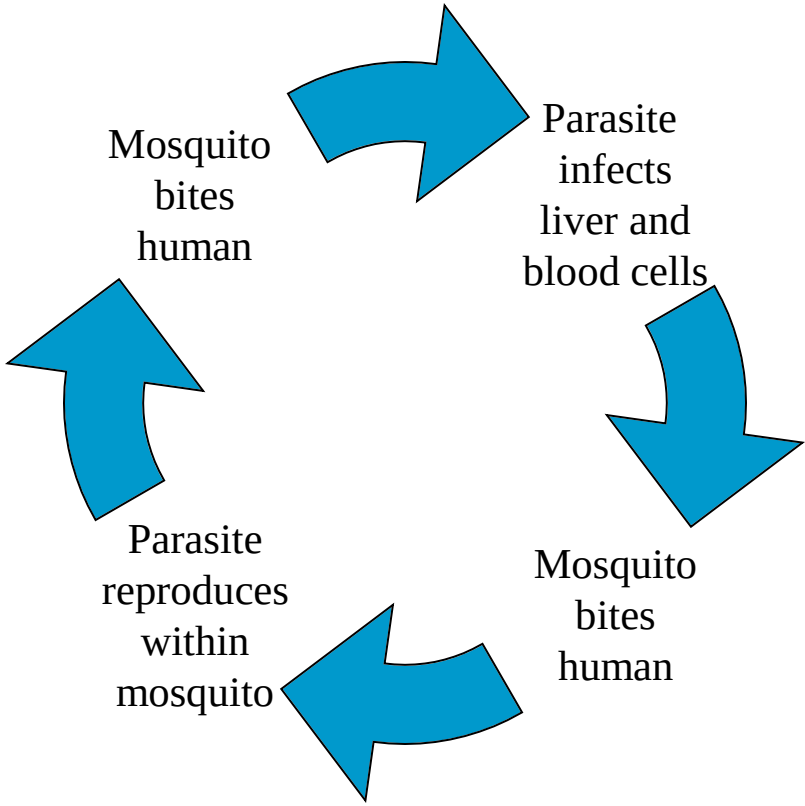
The DDT victory over typhus

- A typhus vaccine did exist by 1943 and many Allied soldiers were vaccinated, but the supply was not large enough for the entire civilian population of Naples
- The standard anti-typhus procedure, already field-tested in Egypt and Algeria, was applied, using two delousing powders, MYL (pyrethrin-based) and DDT
- It proved effective

The typhus vaccine department at the Rocky Mountain Laboratory in Hamilton, Montana (April 1942). Dr Herald Cox at the microscope, while an assistant in the enclosed room inoculates eggs with typhus germs. (John Vachon, 1914-1975, USPHS)

The Case of Malaria and DDT

- Malaria is an ancient disease resulting from the infection of red blood cells by a parasite of the *Plasmodium* genus
- The parasite is transferred to humans by a mosquito bite; it infects liver and blood cells
- A second mosquito bite transfers back the evolved parasite; the next generation is spawned inside the gut, then migrating to the mosquito's salivary glands



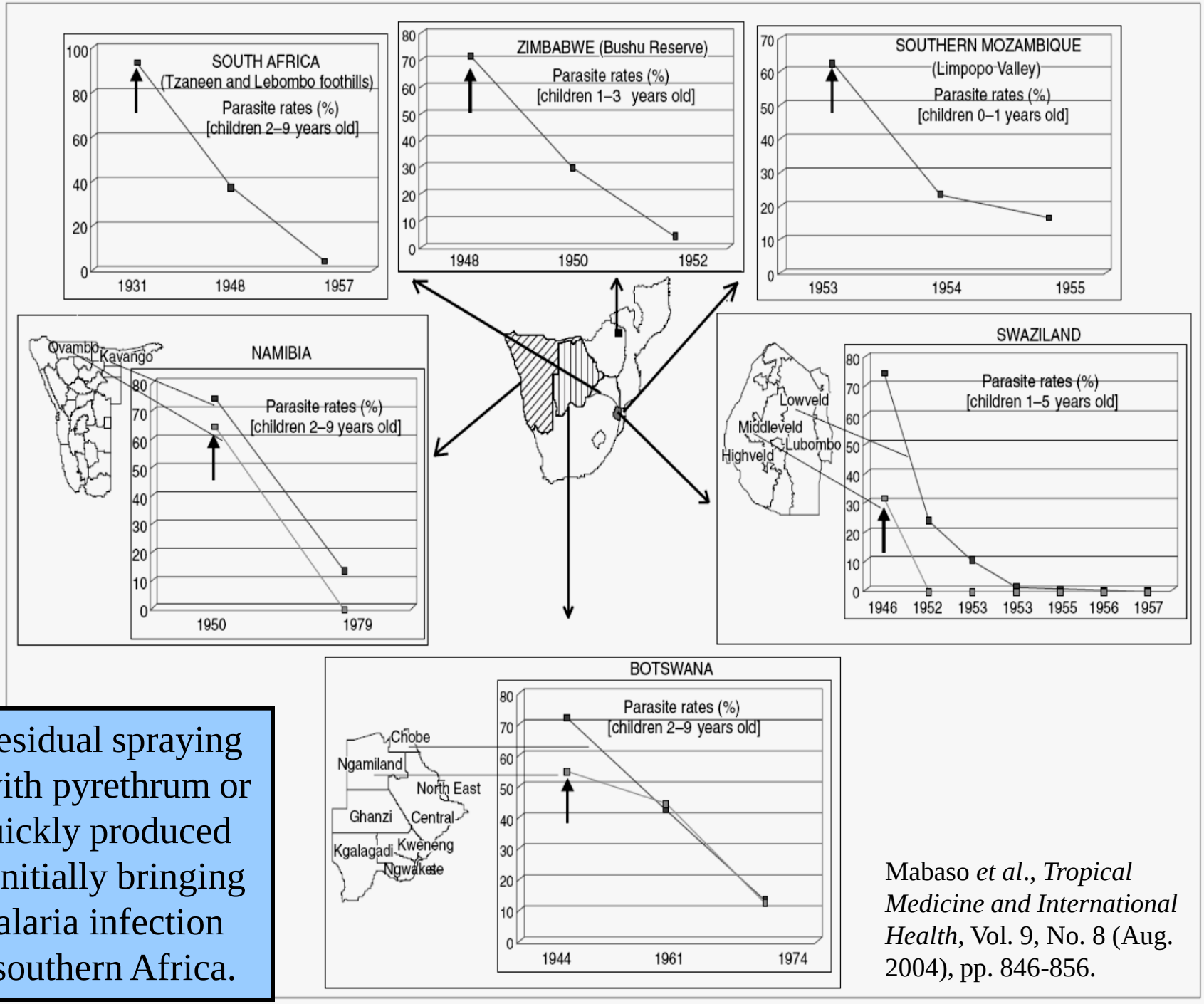
The life cycle of the *Plasmodium* parasite (depicted schematically above) depends on mosquitoes. By killing mosquitoes, DDT could wipe out malaria.

Indoor Residual Spraying

- The alternating of droughts and heavy rains created ideal breeding conditions for mosquitoes in many parts of Africa
- Mosquito-borne malaria was brought under control by the use of DDT as a residual pesticide indoors and as a larvicide, with drugs such as chloroquine used to combat the parasite in humans

Country	Year	Start of IRS and changes of insecticides over time
South Africa	1931	Pyrethrum (experimental IRS)
	1946	DDT and BHC introduced
	1958	Coverage of all malarial areas achieved
	1960–96	DDT
	1997–99	Deltamethrin (policy change)
	2000	DDT (resistance to pyrethroids)
Swaziland	1945	IRS introduced and programme launched
	1947–50	DDT (coverage of all malarial areas in 1950)
	1951–60	BHC (shortage of DDT) dieldrin tried but was costly
	1960–67	BHC and DDT (focal spraying)
	1968–2000	DDT (cyfluthrin in houses with painted walls)
Botswana	1946	IRS introduced (limited scale)
	1950–71	DDT (improved coverage)
	1972	Fenitrothion tried and abandoned (low efficacy)
	1974	Programme launched
	1973–97	DDT
	1998–2000	Deltamethrin and lambda-cyhalothrin (policy change)
Namibia	1965	IRS introduced (limited scale)
	1970	Coverage of all malarial areas achieved
	1965–2000	DDT (bendiocarb in western type residential areas)
Zimbabwe	1945	IRS introduced (pilot projects)
	1949	Programme launched
	1957–62	DDT and BHC
	1972–73	BHC (equally effective as DDT but cheaper)
	1974–87	DDT (resistance to BHC)
	1988–2000	Deltamethrin and lambda-cyhalothrin (policy change)

Mabaso *et al.*, *Tropical Medicine and International Health*, Vol. 9, No. 8 (Aug. 2004), pp. 846-856.



Indoor residual spraying (IRS), with pyrethrum or DDT, quickly produced results, initially bringing down malaria infection rates in southern Africa.

Mabaso *et al.*, *Tropical Medicine and International Health*, Vol. 9, No. 8 (Aug. 2004), pp. 846-856.

The Presentation of Paul Müller's 1948 Nobel Prize for DDT (1)

- "In October of 1943 a heavy outbreak of typhus occurred in Naples and the customary relief measures proved totally inadequate. General [Leon] Fox thereupon introduced DDT treatment with total exclusion of the old, slow methods of treatment. As a result, 1,300,000 people were treated in January 1944 and in a period of three weeks the typhus epidemic was completely mastered. Thus, for the first time in history a typhus outbreak was brought under control in winter. DDT had passed its ordeal by fire with flying colours." (G. Fischer, Royal Caroline Institute, Stockholm, 1948)
- While this encapsulates the standard account, other sources suggest that the U.S. Army's regular delousing powder (MYL) was in abundant supply in Naples and was heavily used during the first dusting actions, with great success

The Presentation of Paul Müller's 1948 Nobel Prize for DDT (2)

- "A short story perhaps illustrates better than many words how the substance acts. In 1945, when DDT was still relatively untried, I met an English Major in Germany who told me he had treated the window pane of his room with DDT since he was plagued by masses of flies. After the DDT solution had been sprayed on, the flies died and lay in heaps on the window ledge. The following morning a German soldier entered and thoroughly cleaned the window. When the Major noticed this he couldn't help crying 'Goodbye my DDT!'. But this farewell was uncalled for. In spite of the thorough cleaning, the window pane retained its deadly action on the flies. This little story amply illustrates how persistent DDT is and how small the dosage required." (G. Fischer, Royal Caroline Institute, Stockholm, 1948)

Pesticides for crop protection

Immigrant workers with crop spraying tractor in Maple (ON) around 1959

Canadian Science and Technology Museum/CN Collection

To recapitulate (3)

- What Swiss organic chemist came up with DDT as a new pesticide?
- What German chemist came up with a new process for the synthesis of ammonia and worked on gas warfare during WWI?
- What two (2) cases of DDT use led to its early acceptance as a miraculously effective pesticide?
- What two (2) diseases associated with insect vectors could be fought with DDT?
- What two (2) elements have become much more common in rivers as a result of domestic and agricultural pollution?

Pesticides: Opposition and Alternatives (1)

- In *Silent Spring* (1962), Rachel Carson argued that the impact of the new organic pesticides (DDT especially) and fertilizers on water quality, the food chain, and the broader environment could not be ignored
- There was a utilitarian aspect to this argument that gained more resonance at a time when smog produced by cars was starting to choke Los Angeles while fall-out from nuclear tests in Nevada was detected in radioactive rain falling over Troy (in upper New York state) in 1953

Pesticides: Opposition and Alternatives (2)

- Montréal-born **Félix d'Hérelle** studied in France, but returned to Canada to produce and launch a maple syrup liqueur
- When this failed, he studied yellow fever in Guatemala as a self-taught bacteriologist and was hired in Mexico to produce a sisal liqueur. He observed the failure of a locust infestation plagued by a coccobacillus...
- He went on to discover *bacteriophages*

Maple Syrup Entrepreneur… and Pioneering Bacteriologist

Félix-Hubert d'Hérelle (1873-1949)

A Pesticide Lexicon

- *Broad-spectrum agent* (or *pesticide*): when applied to a field, it kills all or a large number of the species present; it is not *specific* to one species; it is broadly toxic
- *Pesticide resistance*: when a small number of pests are sufficiently resistant to survive and reproduce, further applications of the pesticide will only select for resistant pests and favour their takeover to an astonishing degree
- *Pesticide treadmill*: the need to use either larger doses of the same pesticide or to switch to a new one, because of: (i) the rise of secondary pests whose predators or competitors have been decimated, and (ii) of the increasing resistance to a given dose or type of pesticide manifested by the pests that have developed a natural immunity or resistance.

The debate over pesticides...

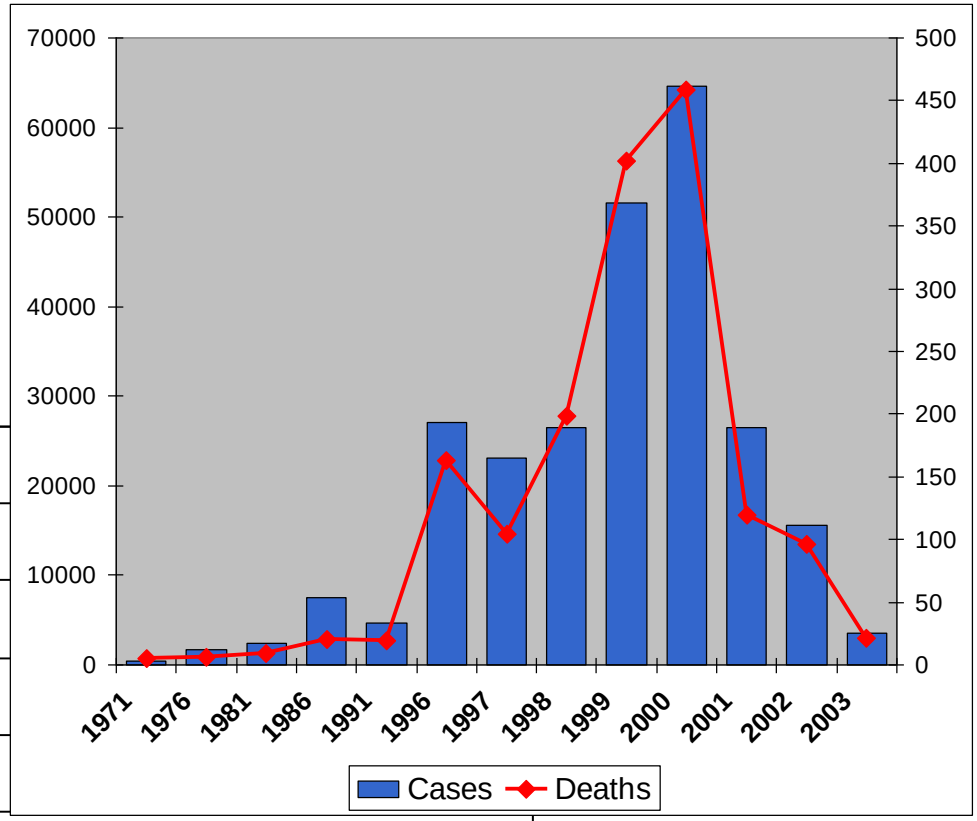
Len Norris, *The Vancouver Sun* (9 June 1964)

The Return of DDT

- Malaria continues to afflict the tropics, but DDT has never been truly replaced
- Today, there is a push to deploy DDT again because it is very cheap, long-lasting, and can be sprayed inside homes in safe quantities
- It has worked in Central and South America, where it was not used for agriculture, and results have been dramatic in South Africa (65% drop in cases over two years), but the main mosquito vector in South Africa was vulnerable (another, *Anopheles arabiensis*, has already developed resistance to DDT)
- Elsewhere in Africa, there are questions about the extent of acquired resistance in mosquito populations since DDT was used extensively for agriculture

Malaria in South Africa

(DDT: banned in 1995/1996, reinstated in 2000/2001)

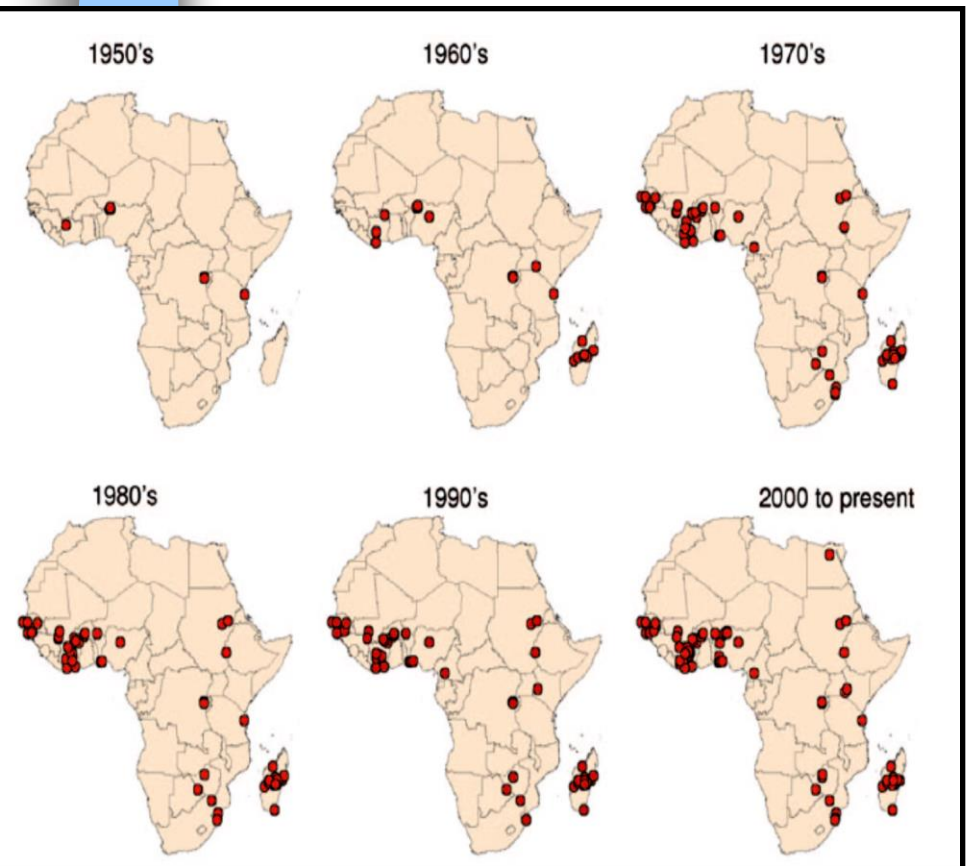


Before July 1999, the number of cases for Limpopo are those for the Northern Province, as well as those for February and March 2000.

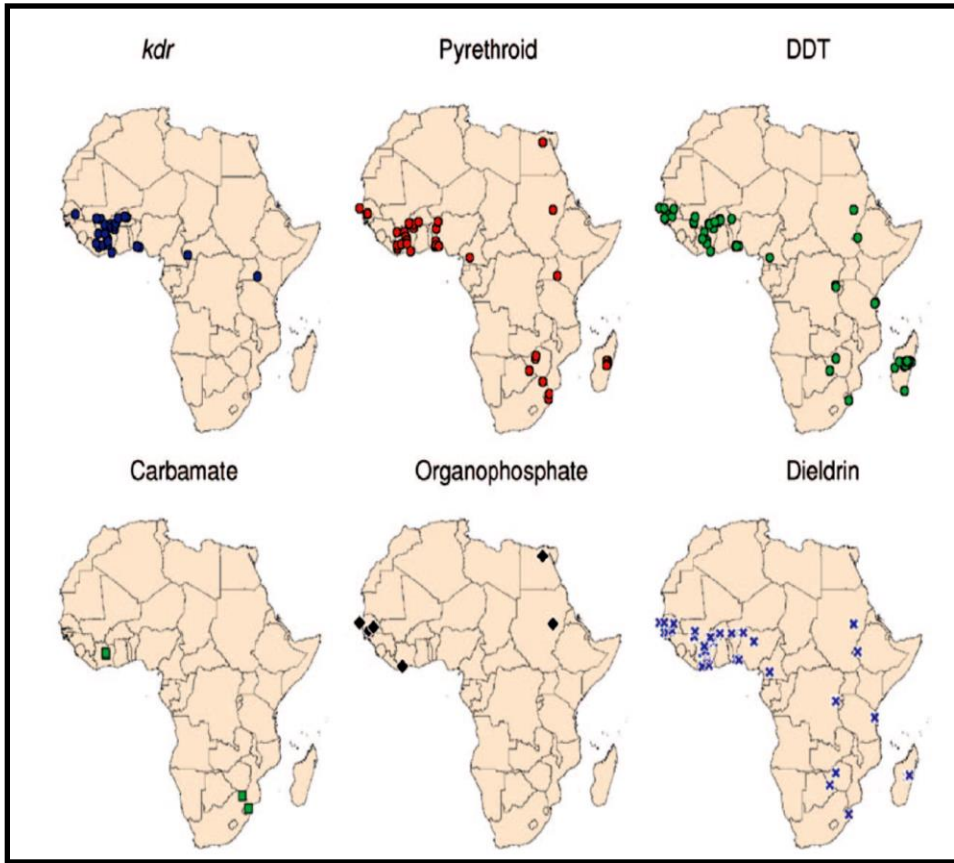
Journal of Medical Entomology, Vol. 43, Number 4 (2006)

Pesticide resistance in Africa

Spread of pesticide resistance in Africa over time



Resistance trait (*kdr*) and resistance to various pesticides in Africa



Limits and Consequences (1)

- Environmentalists and technological pessimists (Jacques Ellul and Herbert Marcuse in Europe; Theodore Roszak and Barry Commoner in North America) carried the day
- In the U.S., the Water Quality Act was passed in **1965**, the Air Quality Act in **1967**, and the National Environmental Policy Act in **1970** (establishing the Environmental Protection Agency)
- When tests suggested DDT caused cancer and proved it thinned the eggshells of wild birds, DDT was banned in the U.S. in 1972, along with other pesticides

Cuyahoga river fire (3 November 1952)

Limits and Consequences (2)

- In **1972**, the Congressional Office of Technology Assessment (ended in 1995) confirmed society's recognition of the concerns of the critics of technology
- It also provided politicians with an independent source of information on the potential impacts of new technologies and the cost/benefits of available alternatives
- It signalled the increasing popularity of technological assessment and studies of the environmental impact of large projects, setting up future debates over new technologies

Limits and Consequences (3)

- In **1972**, the UN held in Stockholm (June 5-16) the Conference on the Human Environment, requested by Sweden as early as 1968
- Presided by Canadian Maurice F. Strong (who would reprise his role in 1992, at the Rio de Janeiro Earth Summit), it pioneered “Only One Earth” as a war cry and launched June 5 as the World Environment Day
- Atmospheric nuclear tests were condemned and traditional ideas of growth were questioned
- The European Union formulated its first environmental action plan the following year

Late in 1969, a U.S. senator, Gaylord Nelson, called for a day of mobilization for the environment. The idea led to a day of marches and rallies (against pollution, pesticide use, and species extinction) on April 22nd, 1970, the first **Earth Day**.

The Scientific Breeding of Chicken

- Even before it was possible to contemplate genetically-modified animals, poultry breeders obtained impressive results, as seen here in a picture of young chickens grown from genetic material representing three strains from three eras

Courtesy of: Mark Zuidhof, Poultry Research Centre, Alberta Agriculture and Food

Making Meat

- **1) directed breeding** (genetic improvement)
- **2) intensive confinement** (controlling temperature, ventilation, sanitation)
- **3) improved nutrition** (vitamin D, corn, soybeans)
- **4) antibiotics, other drugs**

A: Average market weight (lbs)
B: Days needed to reach market weight
C: Feed conversion ratio (lbs of feed/lbs of broiler meat)

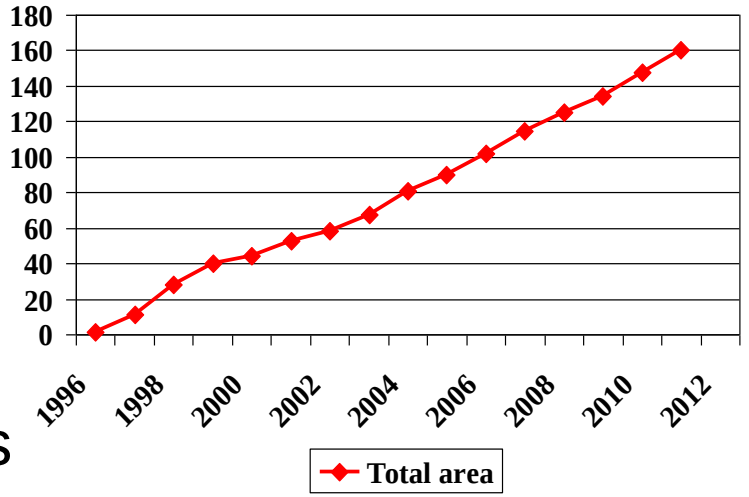
	A	B	C
1935	2.8	112	4.4
1945	3.0	95	3.8
1955	3.1	73	2.9
1965	3.5	*N/A*	2.5
1975	3.8	56	2.1
1985	4.2	*N/A*	2.0
1995	4.7	47	1.9

Source: Boyd, *Technology and Culture*, **42** (2001), p. 637.

Direct genetic intervention

- Genetic engineering have increased agricultural yields, mostly through genetic modifications reducing the harm done by pests
- Monsanto's "Roundup Ready" crops are immune to its Roundup herbicide, so that it is possible to use Roundup to eliminate weeds without affecting the crops
- Other genetically modified (GM) crops resist insect pests both above- and below-ground
- Increasingly, crops combine several biotech traits
- GM crops occupied in 2010 about 10% of global croplands

Total area of biotech crops cultivated worldwide (in millions of hectares)



Transgenic crops, 2006-2012 (1)

Percentage of the world's transgenic crops with selected traits

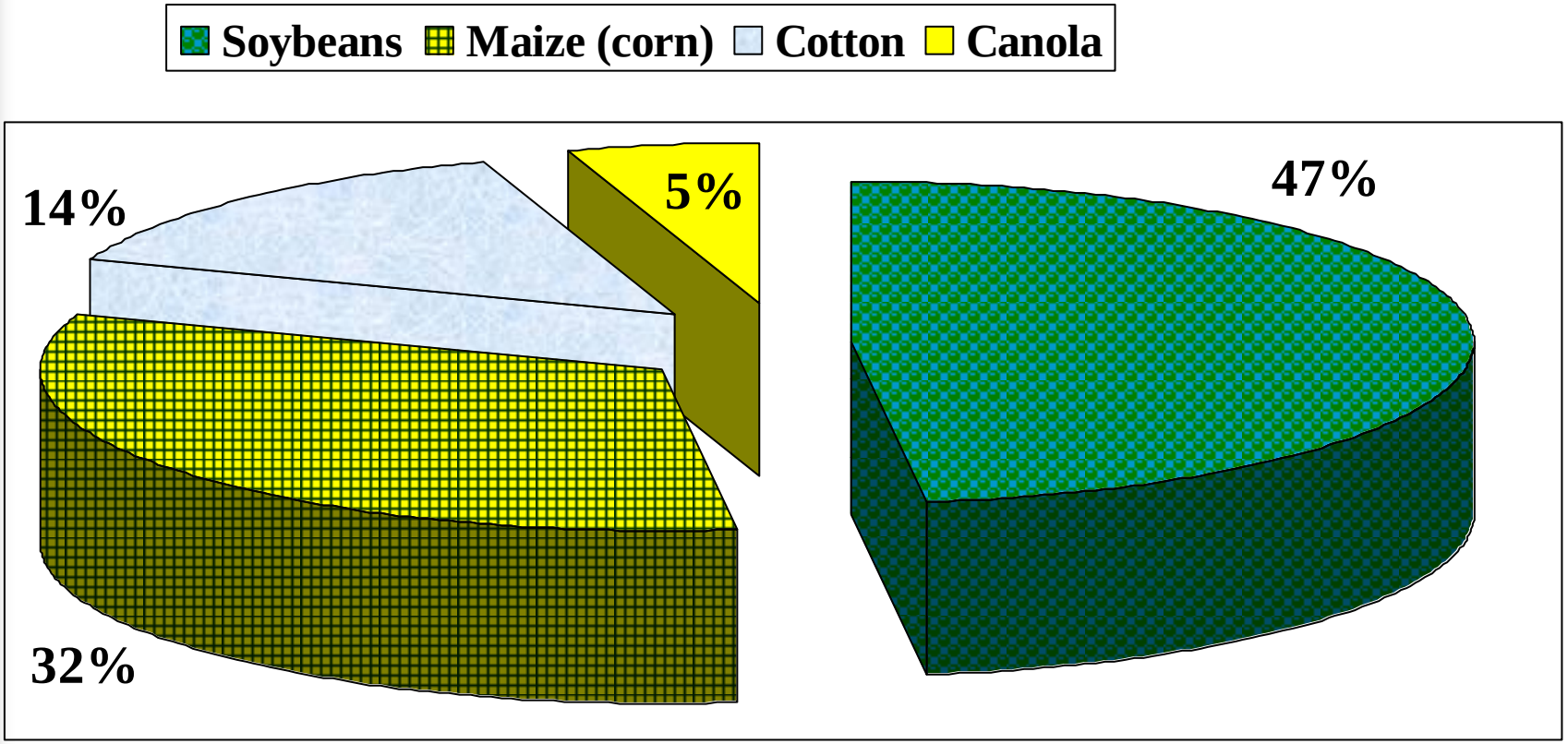
Traits	*Distribution*				
	2006	*2007*	*2008*	*2010*	*2012*
Herbicide tolerance	68%	63%	63%	61%	59%
Stacked traits (Bt/herbicide tolerance)	13%	19%	22%	22%	26%
Insect resistance (Bt)	19%	18%	15%	17%	15%
Virus resistance/Other	—	<1%	<1%	<1%	<1%

In 2003, public researchers in 15 developing countries were investigating 201 genetic modifications for 45 different crops, including resistance to viruses, enrichment in vitamin A, more efficient nitrogen absorption, drought resistance, etc.

Source: Clive James, *Global Status of Commercialized Biotech/GM Crops: 2008, 2010, 2012* (Ithaca, NY: International Service for the Acquisition of Agri-biotech Applications); other ISAAA briefs

Transgenic crops in 2012 (2)

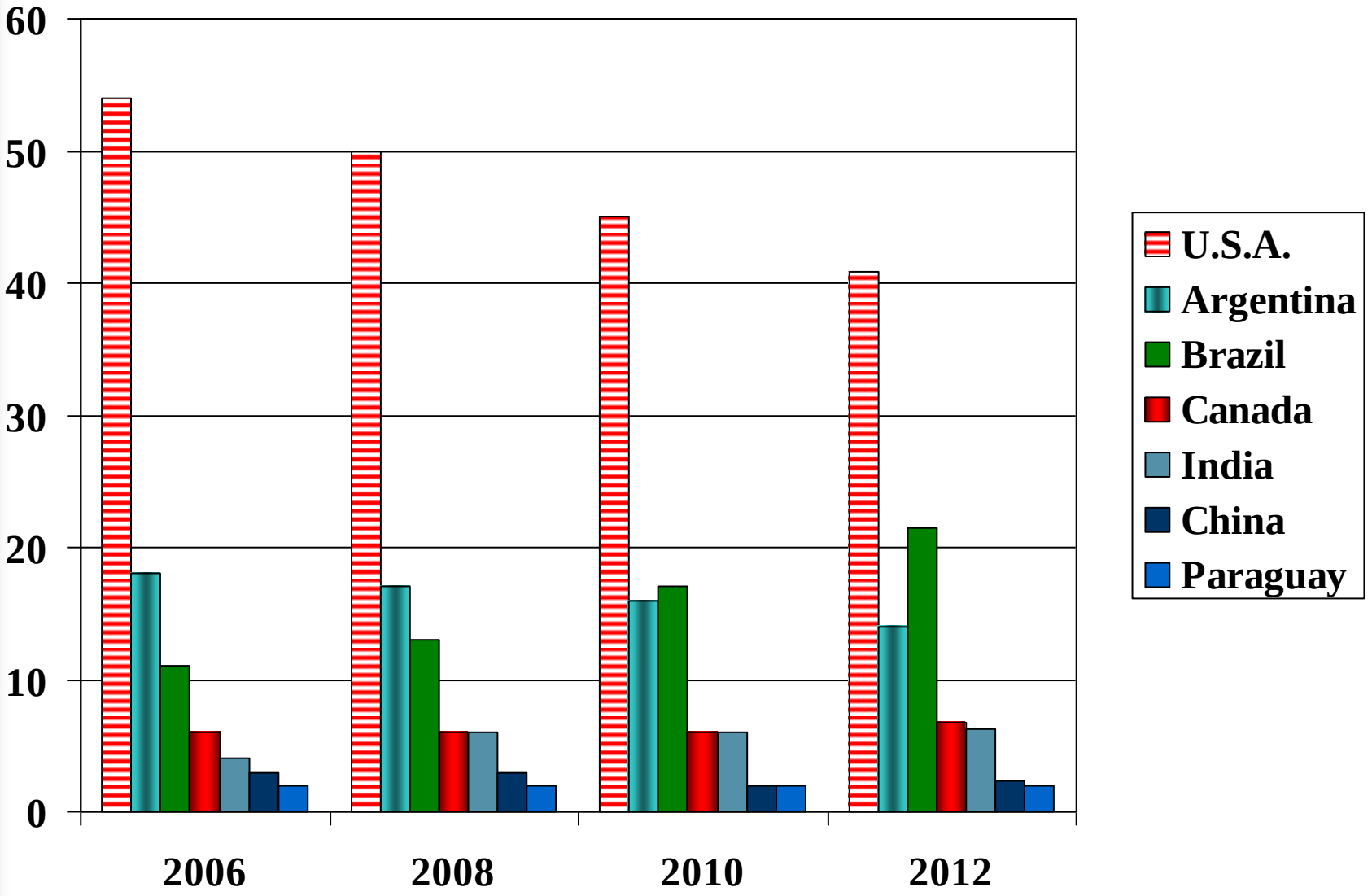
Percentage of the world's total transgenic crop area by crop



Other biotech crops (sugar beet, alfalfa, rice, squash, papaya, potato, etc.) amounted to less than 1% of the total area planted.

Transgenic crops, 2006-2012 (3)

Percentage of the world's total transgenic crop area by country



To recapitulate (4)

- What country grows the most transgenic crops?
- What was the world's most common genetically modified crop in 2010?
- As of 2010, what were the two (2) most common modifications of the world's transgenic crops?
- Are most modern broiler chicken the result of direct genetic modification?
- What author argued that the impact of the new, post-WWII, organic pesticides should not be ignored?
- Name one result of the 1972 U.N. conference on the environment in Stockholm?