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Term Paper

An STS analysis of DDT

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Abstract

In this paper, we perform a STS study on the chemical compound DDT. DDT, despite it's initial success in the 1940s - 1950s, became the centre of a ecological controversy after the release of Rachel Carson's book - "Silent Spring" criticizing DDT for it's harmful properties. Even though it was banned by the EPA in 1972, DDT is still far from gone, still being used to combat malaria and other vector borne diseases all over the world. In this paper, we present a story around DDT and how it's path was shaped by the societal view of this chemical, and despite it's almost reverential following, it was knocked down from it's pedestal and almost ostracized by the global population. We trace this convoluted, roller-coaster story of DDT from the late 1800s right until the early 21st century.

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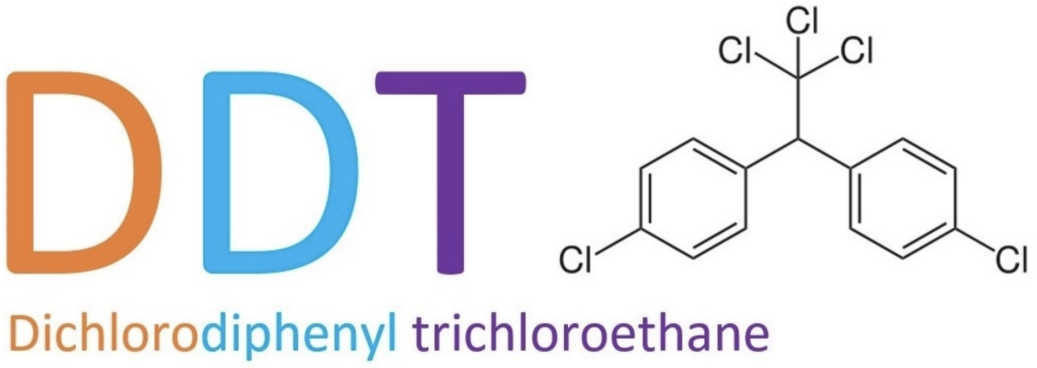

Figure 1: DDT and it's chemical formula

DDT, or dichlorodiphenyltrichloroethane, is a chemical compound which was used as an insecticide for a large part of the 20^{th} century. The unique property of DDT, which gave it an almost unmatched reputation as a wonder chemical for malaria and other vector borne diseases, was it's persistence (effects of DDT would last for over 6-months after spraying). But, during the course of our research, we discovered that DDT was not just chemically persistent, it was also socially persistent, i.e., all efforts to stop DDT use have been unsuccessful so far.

Hence, this paper provides some insight into how DDT occupies an almost unique position in society, where the public is both scared of it's potential side effects, and also scared of the consequences of banning DDT entirely. Through this paper, we will narrate a story about DDT and it's relationship with the world, from the late 1800s to the early 21^{st} century.

2 The Growth of DDT

DDT has very humble origins for a chemical that would eventually reach much of the world. It was first discovered in 1873 by a German chemist named Othmar Zeidler. However, it didn't receive much attention until a 37-year old scientist, Paul Herman Muller, working for a Swiss-chemical company, discovered it's insecticidal properties. He sprayed a small amount of DDT inside a container and realized it slowly but surely killed flies. Even after wiping the container clean, any new flies introduced still died. Muller realized he had chanced across a persistent, powerful residual insecticide.

DDT was developed in an era often characterized by it's scientific and technological advances, and the chemicals legacy is simultaneously triumphant and catastrophic. The early use of DDT during WWII had an almost reverential following, however it's rampant and indiscriminate use quickly garnered criticism. DDT's growth was exponential, and this both reflected and shaped the views of society on science and scientific progress. This history of DDT shows the many ways in which science has been manipulated and controlled throughout history, questions many conventional relationships between science, society and nature.

2.1 DDT during the World War

DDT was first used by the Allies in World War II, to control lice-borne typhus. Typhus had always been a problem during the war, especially in camps for prisoners, detainees or political refugees. Previous to the War, DDT had already proven to be an effective insecticide in controlling the Colorado potato beetles. Hence, almost all the DDT produced in the US was shipped overseas to the soldiers, with almost nothing for the use of the civilian population.

Partly due to it's rarity and also due to it's indispensable role in an army toolkit, DDT became a symbol of the US's war industry and it's fight, with campaigns promoting the use of DDT and other posters asking the public if they were ready to fight both enemies, mosquitoes and the Axis.

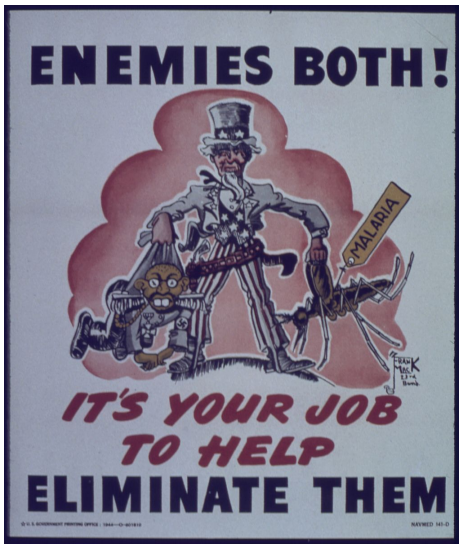

Figure 2: Uncle Sam defeating Hitler with one hand and malaria-transmitting mosquitoes with another [4]

The greatest contribution of DDT to the Allies forces might be stopping the Typhus epidemic in Naples (1944). The military mixed DDT with an inert powder and dusted troops and civilians. Within three weeks the epidemic was under control. Within the first week itself, the number of Typhus cases were halved. The Allies administered over 3 million applications of DDT powder.
For his achievements, Mueller was awarded the Nobel prize for physiology and medicine in 1948. Presenting the prize to Mueller, the Nobel Committee remarked that "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." The committee went on to note that "DDT has been used in large quantities in the evacuation of concentration camps, of prisoners and deportees. Without any doubt, the material has already preserved the life and health of hundreds of thousands. Currently DDT treatment is the sovereign remedy the world over for the prophylaxis of typhus."[3]

Figure 3: Civilians getting sprayed by DDT in Naples

2.2 DDT against malaria

Malaria is a parasitic disease that has plagued mankind for centuries. Malaria was not always a tropical and subtropical disease, until thee 1950s, it was widespread in Europe and North America.

The solution to this vector borne disease was to target the vectors, i.e., mosquitoes. However, until the use of DDT, most other insecticides were ineffective in this regard (respraying every two weeks). DDT was the first insecticide that could last for over 6 months, meaning it could cover more houses and protect more people.

When used to combat Malaria, DDT had three separate mechanisms - repellency, irritancy and toxicity, which together are instrumental in this regard. Repellency was it's most important quantity, and coupled with it's long lasting effects, make it a vital tool in fighting malaria.

Before DDT, the malaria control methods (drainage, larvicide control) were limited to urban areas and malaria was still rampant among the rural population. As soon as malaria was introduced, the number of Malaria cases

fell drastically, and within a few years, Malaria was almost erradicated from Europe

AFRICA	Mauritius	1948	46 395 cases*
		1969	17 cases*
AMERICA	Cuba	1962	3 519 cases
		1969	3 cases
	Dominica	1950	1 825 cases
		1969	Nil
	Dominican Republic	1950	17 310 cases
		1968	21 cases
	Grenada and Carriacou	1951	3 233 cases
		1969	Nil
	Jamaica	1954	4 417 cases
		1969	Nil
	Trinidad and Tobago	1950	5 098 cases
		1969	5 cases
	Venezuela	1943	817 115 cases
		1958	800 cases
ASIA	China (Taiwan)	1945	over 1 000 000 cases
		1969	9 cases
	India	1935	over 1 000 000 cases
		1969	286 962 cases
	Turkey	1950	1 188 969 cases
		1969	2 173 cases
EUROPE	Bulgaria	1946	144 631 cases*
		1969	10 cases*
	Italy	1945	411 602 cases
		1968	37 cases
	Romania	1948	338 198 cases*
		1969	4 cases*
	Spain	1950	19 644 cases*
		1969	28 cases*
	Yugoslavia	1937	169 545 cases*
		1969	15 cases*

Figure 4: Changes in malaria morbidity in countries before and after malaria has been controlled or eradicated [9]

As shown in the figure 4, US and Europe weren't the only countries with successful DDT stories. Within a span of around 20 years, most countries had gotten their malaria cases down to negligible amounts.

In the early 1950s, vector resistance was detected by health experts. WHO, in a move to combat this, decided to overwhelm the mosquitoes by aggressive spraying before resistance could develop. This move ultimately failed due to logistical and economic constraints. However, the meme that DDT resistance was the cause of this campaign's failure is why the public still continue to ignore DDT's main aspect - repellency, which was unaffected by the resistance.

3 The Fall of DDT

During the 1940s, DDT was used extensively as an agricultural pesticide and a household insecticide. However, despite the initial war hero image and it's help in eradicating malaria in North America and Europe, the rise of DDT could not sustain itself for long, and it had its own decline with time.

3.1 Initial Skepticism

Despite the support by the government for its use, there had been growing skepticism over the use of DDT during the 1940s and 1950s. US scientists such as FDA pharmacologist Herbert O. Calvery expressed concern over possible hazards associated with DDT as early as 1944. Dr. Bradbury Robinson, a physician and nutritionist had warned about the use of DDT in agriculture. There was the growing narrative that DDT upsets natural balances by killing beneficial insects and also by the death of fish, birds, and other forms of wild life either by their feeding on insects killed by D.D.T. or directly by ingesting the poison. Many insects, especially pollinators are extremely crucial in agriculture, and a threat to them could mean a decline in agricultural productivity. Since the late 1950s the federal government began tightening its laws related to the use of DDT. In 1957, the Forest Service, U.S. Department of Agriculture (USDA), prohibited the spraying of DDT in specified protective strips around aquatic areas on lands under its jurisdiction. During this time, there was a lot of coverage given to DDT in prominent media outlets like The New York Times where they talked about its potential harms, leading

to greater skepticism towards the pesticide.

3.2 Rachel Carson's contributions

One of the most significant and biggest turning point in the history of DDT happened in 1962, with the publication of the book 'Silent Spring', by Rachel Carson. Carson was an American marine biologist, author and conservationist who began her career as an aquatic biologist in the U.S. Bureau of fisheries, and became a full time nature writer in the 1950s. With the book, Carson had spawned a revolution, and influenced the environmental movement like no one had in the 19^{th} century. The name 'Silent Spring' in itself is a metaphor which would invoke emotions and fear in an American as it signifies how 'Spring', which is a very important part of an American's life, given the extreme winters they face, may in the future be silent, that is, without the chirping of birds.

Silent Spring is an environmental science book which documents the harmful environmental effects of the indiscriminate use of DDT as a pesticide. She referred to pesticides as 'biocides', as the harmful effect of these are barely limited to pests. The book described how DDT entered the food chain and accumulated in the fatty tissues of animals and humans, and caused cancer and genetic damage. She claimed that in laboratory tests on animal subjects, DDT produced suspicious liver tumors. The ecosystem is further hurt as DDT causes harm to birds, fishes and leads to thinning of bird shells. Further, DDT harms many insects, 90% of which are not harmful to humans. Another important issue she addressed was that of increasing resistance amongst pests towards DDT, which would eventually trivialise the benefits of DDT towards combating malaria. The year after it appeared, President John F. Kennedy ordered his Science Advisory Committee to investigate Carson's claims.

4 Narrative around Silent Spring

'Silent Spring' played a major role in altering the public conversation around DDT, however the conversation is one which has not ended till date, and still remains a debated topic amongst social and scientific circles. Many critics of the book and DDT till date argue that the 1972 ban of DDT in the US was

a political one, and not based on science and scientific evidence.

4.1 The environment movement in US and Nixon's 'War on Cancer'

Post World War II and through the 1950s, 60s and 70s, the modern environment protection movement gained momentum in the US. There were several instances which raised concerns amongst the public related to the environment. Some of them include:

- 1954, Lucky Dragon: In 1954, 23 men in the Japanese fishing vessel 'Lucky Dragon' were exposed to radioactive fallout from the United States Castle Bravo thermonuclear weapon test at Bikini Atoll. The incident was covered by the media, and many books and movies were made related to the incident.

- 1968, The Population Bomb: Paul R. Ehrilch' book alerted people to the importance of environmental issues and brought human numbers into the debate on the human future.

- 1969, Santa Barbara Oil Spill: The oil spill occured in January and February 1969 in the Santa Barbara Channel. It was the largest oil spill in US waters by that time.

- 1969, Cuyahoga River Fire: On June 22, 1969, a river fire captured the attention of Time magazine, which described the Cuyahoga as the river that "oozes rather than flows" and in which a person "does not drown but decays".[17]

- 1970, Earth Day: An annual event, first celebrated in 1970 to demonstrate support for environmental protection.

- The Anti-Nuclear Movement: The 1970s saw a surge and support for the Anti-nuclear movement with many organisations coming together and demanding amends. Campaigns which captured national public attention involved the Calvert Cliffs Nuclear Power Plant, Seabrook Station Nuclear Power Plant, Diablo Canyon Power Plant, Shoreham Nuclear Power Plant, and Three Mile Island.

This period was not just a period of protests and activism, but also one where reform took place at a policy level, and many organisations came up. Some major policies initiated by the US during this period were:

- 1960, Federal Water Pollution Control Act
- 1963, Clean Air Act
- 1963, Partial Nuclear Test Ban Treaty signed by the US, the UK and the U.S.S.R.
- 1970, National Environment Protection Act (NEPA)
- 1970, formation of Environmental Protection Agency (EPA)
- 1971, Greenpeace founded
- 1972, Federal Water Pollution Control Act Amendments
- 1972, Marine Mammal Protection Act

All the above incidents played a major role in shaping public opinion regarding DDT. It may be said that Carson's book came at a time when the public was particularly afraid of environmental pollution caused by industries, nuclear technology and there was growing concern for the environment. Furthermore, the National Cancer Act 1971 was passed by President Nixon which declared the 'war on cancer'. Carson had paid specific attention to the carcinogenic properties of DDT (which to date remains scientifically controversial) and cancer was seen as a threat which had to be eliminated. It was the second-leading cause of death in the United States. DDT hence became a word associated with 'fear'. Many from the pro-DDT and anti-Carson side argue that this false image, and fear of DDT was the reason DDT was banned in the US in 1972. They deny any harms of DDT, and criticise Carson in numerous ways, as has been explained in the following sections.

4.2 Personal Criticism of Carson

While many have lauded Carson for her book 'Silent Spring', and for bringing out her research related to harms to the environment, wildlife and humans, she has had her share of opponents who have been vocal at criticizing her. Those in support of Carson, say that her critiques have resorted to personal

attacks on Carson, over questioning her scientific work. They say the opponents have used sexism as a tool to trivialize her work. One critic from the Federal Pest Control Review Board, even went as far as to say "I thought [Carson] was a spinster. What's she so worried about genetics for?"

In another incident, an agricultural expert told a reporter at the Ribicoff hearings, "You're never going to satisfy organic farmers or emotional women in garden clubs" (Graham 1970, 88). She has also been characterized as "hysterical". Sexism has been associated with science since long. Women have been seen as less capable of producing good scientific research as they are suited for 'other' jobs. They were imagined to be less rational, more emotional, and more sentimental than men.

Other opponents have also labelled her as a communist sympathizer. In 1962, at the of the Cold War, criticism of the US struck as unpatriotic or sympathetic with Communism. Former Secretary of Agriculture Ezra Taft Benson wrote privately to former President Dwight Eisenhower that Carson was "probably a communist" (Lear 1997, 429).[19]It has also been said that she is trying to hinder America's ability to produce food.

Some attacks have even denounced her as a scientist, a tool used to reduce the credibility of her work. She was dismissed as an amateur, who had no knowledge of science, as she was not a 'scientist' in the conventional sense. She did not have a PhD, but a MA in zoology, therefore it was easier to dismiss as her as someone who did not understand science. An official of the Nutrition Foundation contended that "publicists and the author's adherents among the food faddists, health quacks and special interest groups are promoting her book as if it were scientifically irreproachable and written by a scientist."

Staunch opponents of Carson have also gone to the extent of labelling her as a mass murderer. They say that Carson is responsible for the millions of deaths caused by Malaria due to the ban on DDT. Michael Crichton once said the ban on DDT to control malaria "has killed more people than Hitler", and many also label the anti-DDT environmentalists as 'Eco-imperialists'.

4.3 Scientific Criticism of Carson

Apart from personal criticism and attacks on Carson, there were many counter-claims and questions to Carson's scientific arguments relating to the harms of DDT. Regarding the scientific hearings held by the Environmental Protection Agency (EPA) to investigate DDT, supporters of DDT say that the administrative law judge in charge of the hearings, Edmund Sweeney, ruled that DDT should remain available for use, and it is not a carcinogenic hazard to man. The hearings lasted for more than eight months, involving 125 witnesses with 365 exhibits. Although Sweeney ruled that any existing uses of DDT should not be cancelled, he was overruled in 1972 by the administrator of the EPA, William Ruckelshaus, who did not attend one hour of the hearings. According to a report in the Santa Ana Register quoting Ruckelshaus's chief of staff, Marshall Miller, Ruckelshaus did not even read the entire hearing report.

Many counter-claims have also been produced related to the human health impacts of DDT due to bio-accumulation. They claim as written in an article written in 2000, The Lancet, "Ingestion of DDT, even when repeated, by volunteers or people attempting suicide, has indicated low lethality, and large acute exposures can lead to vomiting, with ejection of the chemical." Furthermore, "If the huge amounts of DDT used are taken into account, the safety record for human beings is extremely good."[] They also cite research to show that DDT is safer than coffee. Other critiques claim that the bibliography cited by Carson is filled with unscientific sources.

5 The Return of DDT

After the ban and public discourse around DDT, most countries switched to alternatives (e.g. pyrethroids). This led to one of the worst malaria epidemics in countries like South Africa. Over 4 years, Malaria cases increased oveer 800%.

Meanwhile, the discourse against DDT was also gaining traction, pulling groups such as the World Wildlife Fund (which had previously shown no interest in malaria) due to the claims made by Carson. DDT was frequently grouped with carcinogenic and provably harmful chemicals ("dirty dozen") and many green movements aimed to completely ban DDT.

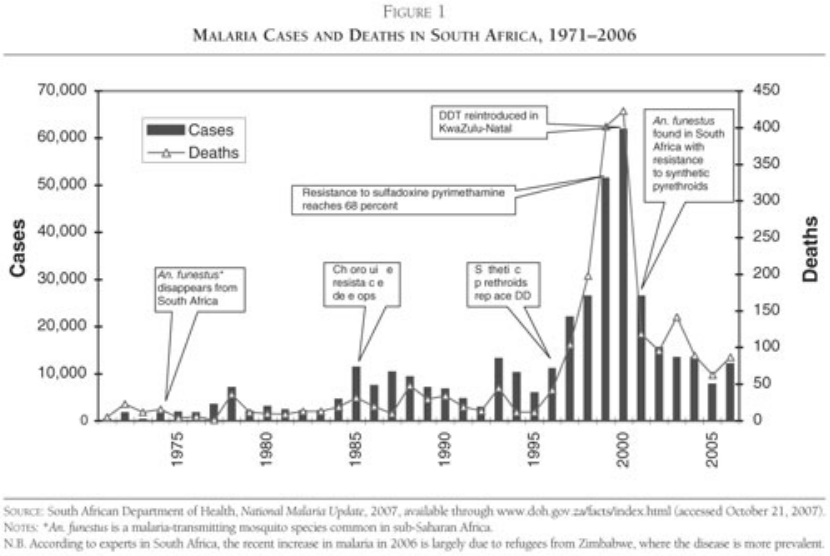

Figure 5: South Africa's malaria situation after the DDT ban

Setting a target for it's demise, these groups campaigned to ban the supposedly deadly chemical once and for all. But, coincidentally, since Johannesburg was chosen as the location of the final summit in 2000, and malaria cases were on the rise in South Africa, the agenda failed, with DDT being "phased out" when cost-effective alternatives were found.

After reintroducing DDT, the malaria cases dropped by nearly 80% in just a year. After 5 years, the number of deaths by malaria were down by 97% from their previous high of 41,786 in 2000. Due to their success story, many other countries reintroduced DDT into their national health program.

Even in thee US, president George W. Bush announced the President's Malaria Initiative (PMI) in 2005, and DDT was aimed to be a major part of it. For over 50 years, DDT was recommended by WHO to combat vector borne diseases like malaria, even during the rising agitation against DDT. Due to the lack of any alternatives, and the presence of any proven side effects to humans, WHO continued it's support for DDT.

6 The Current Status of DDT

DDT as of today is universal with a symbol of death and disease. It has garnered a negative connotation, and it's association with carcinogenic substances cannot be easily broken now. Despite the lack of clear scientific evidence against DDT, the public hearing resulted in it's implicit ban from all but the most extreme situations of epidemics. In a way, the move to ban DDT was driven by a social and political factor, rather than a scientific one. Now, due to the ever increasing pressure, even WHO and other organisations who had been ambivalent towards DDT earlier, are reconsidering their positions.

Figure 6: Using sentiments and emotions in the fight against DDT

There is increasing bias in academic literature, with a greater number of scientists blindly jumping on the "anti-DDT" bandwagon as a way to fast track their careers. To cite [6]: *A recent article in The Lancet Infectious Diseases alleges that superior methods for malaria control exist–without providing a single reference for this claim. The authors claim that DDT represents a public health hazard by citing two studies that, according to a 1995 WHO technical report, do not provide "convincing evidence of adverse effects of DDT exposure as a result of indoor residual spraying." Furthermore, the authors misrepresent those defending the use of DDT. They claim that supporters view DDT as a "panacea"–dogmatically promoting it at every opportunity–yet they do not provide any evidence to back up their opinion.*"

7 Concluding Remarks

In this paper, we present a historical outlook on DDT (from the late 1800s to the early 21st century). We showcase the dual nature of the arguments, where each side asks different questions regarding the issue of DDT, and fails to clash with the other. Very seldom does an issue have such diverse and convoluting arguments both for and against it. We believe that this analysis of the DDT issue is a never-ending cycle between voices both for and against the use of DDT. Even after spending much time researching about it, and analyzing the arguments, we are still at a perpetual state of confusion.

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