DDT

AND NEWER PERSISTENT INSECTICIDES

by

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AUTHORS' PREFACE

TO FIRST EDITION

IT is now clear that DDT has properties unlike those of any material hitherto employed in controlling insects. Optimum use of the dramatic residual effect of DDT can probably be assessed with any certainty only by experiments under field conditions, as it is obvious that the type of surface, the manner and formulation in which the DDT is presented, climatic conditions, the amount of rubbing to which the surface is subjected, and other variables, may influence the results. We present this book now rather than later because, although the academic worker may be in a position to assess the already extensive world literature on DDT, the field worker, often remote from libraries, will, we hope, find this survey helpful. The authors have been associated with DDT since its consideration and adoption by the appropriate authorities of the United Nations, and it fell to the lot of one of us (G. A. C.) to introduce this Swiss product to the British authorities in December 1942. For this reason we felt that a first-hand description of some of the trials and tribulations and the great efforts made by the team of experts brought together by Professor Sir Ian M. Heilbron, D.S.O., F.R.S., would be of interest to readers, and we overcame our diffidence in mixing the "personal" with the "impersonal" and maintaining the detachment necessary in abstracting and reviewing by using the device of a Prologue. At the end of the book we have attempted to step through the "looking-glass" which separates to-day's academic knowledge from to-morrow's practical applications with all the great expectations, the difficulties and disappointments.

We hope to keep the book up to date by adding later references if new editions are warranted. We should welcome suggestions for improving and extracting the full usefulness of the book and we should be happy to keep in touch with workers both in the laboratory and in the field. We should be grateful if any queries, suggestions or reprints be sent to us, care of Messrs. Chapman and Hall, 37, Essex Street, London, W.C.2.

Finally, we acknowledge with gratitude the assistance of Miss Beryl O. Sparham and Mrs. F. M. Weed in correcting the proof of this book.

T. F. W.
G. A. C.

November 1945

AUTHORS' PREFACE

TO SECOND EDITION

WHEN the first edition disappeared with such, to us, gratifying rapidity we were faced with the alternative of reprinting or attempting at short notice the preparation of a second enlarged edition to include the mass of work which has been published during 1945–6. It says much for the charm of Mr. J. L. Bale in that not only have we attempted this onerous task, but we have enlarged the scope to include newer persistent insecticides based on the chlorination of hydrocarbons. Not unnaturally, the gradual realisation of the implication of the discovery of the insecticidal properties of DDT has led to intensive preparation and investigation of chlorinated hydrocarbons. The story of these endeavours rounds off the picture—and indeed is essential—to present the full importance of DDT itself.

We write this in the full realisation that the story is only beginning and that any future editions may well appear amid new and dramatic developments in this field of endeavour.

In our first preface it was implicit that the time was not then ripe for a critical résumé describing the *status quo* in various fields —especially agricultural applications. From conversations with experts in England and other countries we were gratified to have this approach approved. We feel that the time is still not opportune and that workers all over the world remain as much interested in experimental method as in the actual result. We hope that readers will consider this early second edition justified and although it includes references to work of varying quality we hope that general trends of development will emerge.

We decided to retain the prologue on account of its historical interest, but after publication of the enormous number of papers during the past year the epilogue of the first edition was no longer apposite. The opening of communication with Switzerland has permitted first-hand accounts of those interesting early stages in the DDT story, and Chapter I has been completely re-written. The outstanding chemical work of Haller and his collaborators and of the Swiss workers has necessitated the re-writing of Chapter II. In Chapter XII we have quoted in full the excellent Table prepared by Major L. H. Kent, to whom our best thanks

for advice are due. We acknowledge with gratitude the kind assistance of Professor G. R. Cameron, F.R.S., in reading in manuscript Chapter IV and the Toxicology section on benzene hexachloride (Chapter XV).

Finally, it is with great pleasure that we express our thanks to Miss Eileen Hersey for assistance during long week-ends of tiresome correlation of the abstracts, and we are grateful to the many workers who have lightened our task by sending reprints.

T. F. W.
G. A. C.

September, 1949

IMPORTANT NOTE

Such are the frustrations and difficulties of post-war publishing that it has taken a considerable time for the production of this new edition.

But, in the meantime, work has gone on and results have piled up. In an endeavour to facilitate the spread of this knowledge, we have included a literature survey to 1948, arranged on the same classification as the book itself. It may not be complete, but it is nevertheless extensive and, we hope, useful.

There is much to be said for the preparation of a critical appreciation of the now wide range of available insecticides, but this is not attempted in the present edition. Nevertheless the story of DDT itself is still of great significance and has been the source of much inspiration in laboratories and large-scale field experiments throughout the world. The methods by which it has been applied against a wide variety of insects are still, therefore, sources of information to other workers and, for this reason, we hope the manner of presentation is approved.

T. F. W.
G. A. C.

February, 1950

ABBREVIATIONS OF REFERENCES

Agric. Gaz. N.S. Wales	Agricultural Gazette of New South Wales
Amer. J. Publ. Health	American Journal of Public Health
Ber.	Berichte der deutschen chemischen Gesellschaft
Biochem. Bull. (China)	Biochemistry Bulletin (China)
Brit. Ch. Abs.	British Chemical Abstracts
Brit. Med. Bull.	British Medical Bulletin
Brit. Med. J.	British Medical Journal
B.P.	British Patent
Bull. Entomol. Res.	Bulletin of Entomological Research
Canadian Journ. Comp. Med.	Canadian Journal of Comparative Medicine
Ch. Abs.	Chemical Abstracts
Chem. & Eng. News	Chemical and Engineering News
Chem. and Ind.	Chemistry and Industry
Chem. Met. Eng.	Chemical and Metallurgical Engineering
Contr. Boyce Thompson Inst.	Contributions from Boyce Thompson Institute
Helv. Chim. Acta	Helvetica Chimica Acta
Ind. Eng. Chem. (Anal.)	Industrial and Engineering Chemistry, Analytical edition
Ind. Eng. Chem.	Industrial and Engineering Chemistry, Industrial edition
Ind. Eng. Chem. News ed.	Industrial and Engineering Chemistry, News edition
Ind. Chem.	The Industrial Chemist
J. Amer. Chem. Soc.	Journal of the American Chemical Society
J. Amer. Med. Assoc.	Journal of the American Medical Association
J. Assoc. Off. Agr. Chem.	Journal of the Association of Official Agricultural Chemists
J. Biol. Chem.	Journal of Biological Chemistry
J.C.S.	Journal of the Chemical Society
J. Council Sci. Ind. Res. Australia	Journal of the Council of Scientific and Industrial Research of Australia
J. Econ. Ent.	Journal of Economic Entomology
J. Investigative Dermatology	Journal of Investigative Dermatology
J. Lab. clin. Med.	Journal of Laboratory and Clinical Medicine
J. Min. Agric.	Journal of the Ministry of Agriculture
J. National Malaria Society	The Journal of the National Malaria Society
J. Oil Col. Chem. Assoc.	Journal of the Oil and Colour Chemists' Association

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J. Org. Chem.	Journal of Organic Chemistry
J. Pharmacology	Journal of Pharmacology
J. Pomology	Journal of Pomology and Horticultural Science
J. Roy. Hort. Soc.	Journal of the Royal Horticultural Society
Journ. Roy. Soc. Arts	Journal of the Royal Society of Arts
J.S.C.I.	Journal of the Society of Chemical Industry
J. Wildlife Management	Journal of Wildlife Management
Man. Chem.	Manufacturing Chemist
Mitt. Schweiz. ent. Ges.	Mitteilungen Schweizerischen entomologische Gesellschaft
New Zealand J. Sci. Tech.	New Zealand Journal of Science and Technology
Pharm. J.	The Pharmaceutical Journal
Proc. Roy. Soc. Med.	Proceedings of the Royal Society of Medicine
R.A.E.	Review of Applied Entomology
Schweiz. med. Woch.	Schweizerische medizinische Wochenschrift
Schweiz. Ztschr. f. Obst. u. Wein.	Schweizerischen Zeitschrift für Obst-und Weinbau
Trans. R. Soc. Trop. Med. Hyg.	Transactions of the Royal Society of Tropical Medicine and Hygiene
U.S. Dept. Agric. Bur. Ent. Plant Quarantine	United States Department of Agriculture Bureau of Entomology and Plant Quarantine
U.S. Publ. Health Rep.	United States Public Health Report

ABBREVIATIONS

gal.	gallon	%	percentage
gals.	gallons	cu.	cubic
g.	gram or grams	m.	metre
mg.	milligram or milligrams	ft.	feet
kg.	kilogram or kilograms	sq.	square
oz.	ounce	p.p.m.	parts per million
ozs.	ounces	mol.	molecule
lb.	pounds	mols.	molecules
ml.	millilitre or millilitres		

CONTENTS

PART TWO

NEWER PERSISTENT CHLORINATED INSECTICIDES

APPENDIX

PROLOGUE

HISTORY AND DEVELOPMENT

"The discovery of DDT indubitably heralds a new era in man's ceaseless fight for mastery against disease."

SIR IAN M. HEILBRON

EVEN in these days of intensive research it is an unusual experience to witness, within the short period of one decade, an original discovery pass through all its laboratory stages of test and trial, to develop into a major factor of change. Briefly, this is the story of αα-bis-(*p*-chlorophenyl)-βββ-trichloroethane, more loosely—and with greater convenience—called *di*chloro-*di*phenyl-*tri*chloroethane (DDT).

The insecticidal properties of the compound were discovered in the Basle laboratories of the Swiss Company of J. R. Geigy S.A. by Dr. Paul Müller in the autumn of 1939 and patent application was made in Switzerland on 7 March 1940.[4] The new insecticide quickly proved exceptionally effective by checking the plague of Colorado beetle in 1941 which threatened the Swiss potato crop at a time when all food crops were of the utmost importance. The difficulties of communication at that time, when German and Italian troops surrounded the one remaining outpost of Democracy in Europe, restricted the spread of this information to the free world, and the thoroughness of the Swiss manner of testing and re-testing occupied a further year or so while the insecticidal action was established for a wide range of insects, including the flea beetle and the carrot-fly, the louse, the mosquito and the housefly. Thus, when ultimately introduced into the United Kingdom and the U.S.A. towards the end of 1942, much was known concerning the compound.

There are, therefore, two main aspects of the development: the earlier period of the more fundamental discoveries in Switzerland, and the later one in the United Kingdom and the U.S.A. when DDT was harnessed to the war machine and investigators carried out countless researches, most of which are still unpublished, but some of which have recently appeared in print.

It fell to the lot of one of us to introduce DDT to the British authorities, and this is the story of those early months at the end of 1942 and the beginning of 1943 as we saw it.

When J. R. Geigy S.A. first managed to communicate the news of their insecticidal preparation, Gesarol*, to the British Geigy Company, they also communicated some interesting results already obtained with this product to the British Legation at Berne, and the British Consul at Basle, and to the corresponding U.S.A. officials. By some means or other they also managed to send over several hundredweights of Gesarol, which was described as containing 5% "active ingredient". The clue to the nature of the active ingredient was to be found in British Patents 547871 and 547874 held by J. R. Geigy S.A. of Basle.

The Swiss results were impressive. Dr. Paul Müller, who discovered the insecticidal properties of DDT, drew attention to its lasting effect and to its increased potency when properly compounded into 5 or 10% dusts and spray powders which became the basis of the Geigy Gesarol preparations. With Gesarol successful control had been obtained of the flea beetle in cabbages and radishes, apple-blossom weevil, apple sawfly, raspberry beetle, cabbage moth, and Colorado beetle in potatoes. Special preparations were already recognised in Switzerland to control insects such as grain weevil (*Calandra granaria* and *Calandra oryzae*) attacking food grains during storage. Neocid preparations were already used against lice, fleas and mites, and had undergone extensive tests in schools and refugee camps.[1] These preparations had proved effective against flies and mosquitoes in rooms, barracks and farm buildings.[2] Extensive toxicity tests had also been carried out under the direction of Dr. Domenjoz in Basle[2] to determine the effect of Gesarol and Neocid compositions against man and warm-blooded animals, and sufficient evidence was accumulated to show that there were no hazards in the applications contemplated.

It was decided, however, that in Britain there must be British tests on British plants with British pests and climatic conditions (just as in America similar decisions were being taken with reference to American tests), and with this end in view it was decided to introduce Gesarol to the chief testing stations. So it came about that at Rothamsted just before Christmas 1942 Gesarol was first introduced to Dr. Tattersfield. Accumulating evidence soon convinced him that there was a prima facie case

* Gesarol and Gesapon (soft 'g') were the original Geigy names which are used by Geigy on the Continent, and in the U.S.A. In England these names could not be registered with the soft 'g' owing to several competing trade names, so they have become Guesarol and Guesapon. Both versions will be found in the book, according to the source from which the reference is taken.

for taking it a stage further with his own recommendation, and soon Gesarol was introduced to Mr. Fryer and Mr. Gimingham at the Plant Pathology Laboratory, Harpenden, and through them it received the attention of the Agricultural Research Council. It was interesting to hear at the Plant Pathology Laboratory that they already had heard of Gesarol in French and Italian references to Geigy work, and had actually received a small sample of Gesarol a few days previously from a locust officer in Persia who sent it as something "worthy of interest".

About this time also (January 1943) a further document arrived from Basle—news of the startling successes of Neocid, a dust also containing 5% active ingredient, against the louse.

The story to this point of development in Switzerland may be gathered from the following account given by Mooser[1]—

"The effectiveness of this new substance is above all of interest in hygiene. It has been used by J. R. Geigy for destroying human and animal parasites, under the commercial name of Neocid, soon after Dr. Domenjoz—at Läuger's suggestion—had carried out the first fruitful experiments with lice and fleas in his pharmacological laboratory in the winter of 1941–2. Soon the action of Neocid against clothes lice was confirmed to be 100% successful, in the Hygiene Institute of the University of Zurich. As soon as the lice came in contact with Neocid they fell to the ground; the symptoms of poisoning being similar to those observed with flies. According to the concentration, the lice were dead in 12 to 48 hours. Neocid proved to be ineffective against the nits, but because of the lasting action of Neocid, the young lice were poisoned as soon as they developed from the egg.

"On the 18 September 1942, in Geneva, I gave a lecture to the doctors of the First Army Corps on typhus and its prevention. I described our laboratory experiments with Neocid against clothes lice and spoke of the possibilities this new substance offered for the prevention of typhus epidemics. Mr. R. Bochringer, a layman, the Chief of the Mixed Commission of the International Committee of the Red Cross, who was present, emphasised the significance that this simple and inexpensive substance would have. At his request, the firm of Geigy were working with the Red Cross in carrying out experiments in the fever-ridden districts in the Balkans.

"Neocid had been used in the Swiss Army since the spring of

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1943 against parasites and in aerodromes since the summer of 1942. In September 1942 Geigy had placed at the disposal of the Swiss Army commander a ton of Neocid powder."

This report of the action of Neocid against the louse was also discussed with Dr. Tattersfield, who brought it to the notice of Professor P. A. Buxton, F.R.S., and Dr. V. B. Wigglesworth, F.R.S., at the London School of Hygiene and Tropical Medicine, and Professor J. W. Munro at the Imperial College of Science and Technology, who were the chief Government authorities in the Army fight against the louse and the mosquito.

It was at this stage that the speed of the investigations was suddenly transformed, and Professor Sir Ian M. Heilbron, D.S.O., F.R.S. (the Chemical Adviser to the Ministry of Production), who set up the Insecticidal Development Panel of Experts, to overcome the position arising due to the shortage of pyrethrum and derris, gathered around him teams of workers who investigated all relevant war-time application, and he put the whole force of the Ministry of Production to initiate and expedite the manufacture of this new synthetic insecticide for which the name DDT was coined by an official of the Ministry of Supply.

Much has been written about the American work on DDT at this period, but the same patient though as yet unpublished work was proceeding in this country. For the moment horticultural and agricultural applications had to be deferred and the chief attention given to the fight against the louse and the mosquito —the Service requirements. New preparations in powders, solutions, and emulsions were formulated, examined, and tested biologically at stations all over the country. Textile processing firms and research stations were asked to work out the details for the impregnation of shirts and underwear to give garments capable of killing lice. Fly and mosquito sprays were worked out utilising the deadly properties of DDT for barracks and kitchens, especially in tropical and semi-tropical countries. The chemistry of DDT and many related compounds was studied. Though the Geigy work was found to be solid and thorough, there were local conditions requiring adjustment, and chloral—one of the raw materials hitherto made only in small quantities in this country and with variable results—had to be made in greatly increased quantities.

Above all, extensive tests were carried out under Professor

G. R. Cameron on the toxicology of DDT and its effect on man and warm-blooded animals. The details of such tests are dealt with in a later chapter, but it should be said here that literally hundreds of animals were experimented upon before DDT was used in the Services. It was administered by the mouth, cutaneously and sub-cutaneously; it was rubbed on the skin, with and without the presence of fatty oils (which increase the activity of DDT), and then a complete history of any pathological symptoms recorded. Post-mortem examination was carried out on all the important organs and tissues, and microscopic slides made for the examination of the degree of affection. The decision was finally made in favour of the use of DDT and the four years' experience of large-scale application has justified these decisions by the absence of any hazards from the accepted methods of application.

The beginning of 1943 was a most difficult period for British industry. Plant and labour even for essential purposes were almost unobtainable. To make the best with what was available was the order of the day, and difficulties arose at every stage. At the Ministry of Supply the powers of organisation, enthusiasm, and optimism of the chief officers of the Departments eliminated red tape and overcame the complications of supply due to the war. In Manchester, at the Trafford Park works of the Geigy Company, there was a drive for the erection of plant and the production of DDT.

DDT at that time became a war priority of the highest order, ranking with penicillin and radar, and nothing was allowed to stand in its way. Even so, the times themselves were so difficult, and the labour resources of the country so strained—especially skilled labour for plant construction—that it was a constant race against time. . . .

As early as January 1943 a few pounds of DDT of high purity were made in the Geigy Fine Chemical Laboratories at Trafford Park, and in April 1943 the first batch was produced on the pilot plant. This plant continued to produce several tons throughout the following months until the first bulk production came forward in Trafford Park in November 1943. This was the first regular large-scale production outside Switzerland and was the climax of an effort of co-operation between plant engineers, chemists, industrialists, biologists, and Government officials. Meetings were frequently held where several Ministries were represented so that

the way to production and still greater production could be smoothed. Sir John Anderson, Lord Wavell, and Lord Louis Mountbatten were reported at one meeting as being very anxious that all resources should be pooled to increase output. The Prime Minister himself requested that all Ministries concerned should urge DDT production to the utmost of their resources.

Meanwhile it now becomes apparent that similar action was being taken in the U.S.A., and it has been interestingly recorded by Victor Froelicher as follows:[2]

> "In September 1941, J. R. Geigy of Basle, Switzerland, our parent company, informed us of a new insecticide which, in the form of a 1% dust had been found extremely effective against the Colorado potato beetle. This information did not seem to be extraordinarily important because the Colorado potato beetle had already been successfully controlled in the United States with lead arsenate. . . .
>
> "We received a report dated 12 June 1942, indicating the extraordinary results obtained in tests run with 'Gesarol', an agrioultural insecticidal composition. About 150 tons of this material were used during 1942 in Switzerland (pop. four million). In August 1942, Major A. R. W. De Jonge, American Military Attaché at Berne, Switzerland, had shown great interest in our new lousicidal composition called 'Neocid', which contained the same active ingredient as the 'Gesarol' products. It was indicated that 'Neocid' had great significance in controlling the typhus-carrying body louse. On 16 October 1942, we contacted Dr. R. C. Roark at Washington, and handed him a Swiss report giving the results of tests which had been made with 'Gesarol' on a great variety of insects, some of which, like the Colorado potato beetle, are familiar to us in the United States. . . .
>
> "Dr. H. L. Haller at Beltsville extracted the active ingredient in 'Gesarol' and analysed and synthesised some of the active ingredient in his laboratory, simultaneous with which there arrived from Switzerland the information of its chemical composition. . . .
>
> "The manufacture of the product was studied in the United States. This work was mainly carried on at the Orlando Station of the United States Department of Agriculture by 29 scientists under the direct supervision of Dr. F. C. Bishopp, Dr. W. E. Dove and E. F. Knipling. The results obtained were so spectacular that the Surgeon-General's Office and the Office of Scientific Research and Development became very interested.

With little current information regarding the manufacture, Cincinnati Chemical Works, Norwood, Ohio, which is partly owned by Geigy, Switzerland, was called upon to solve the manufacturing problems . . . pilot plant production was started in May 1943."

It was evident, however, that no one firm in this country (Great Britain) could deal with the tremendous Service demand for DDT. Even a dozen firms would be compelled to strain their resources and pool their knowledge to achieve results.

From this time, therefore, the scientific and technical workers engaged on the production, formulation, and application of DDT became very great in number, and it is impossible to follow their work in further detail owing to the war secrecy in which much of it was enshrouded—secrets shared by thousands, but yet not noised abroad, and discussed only where something was to be achieved by the discussion. During 1943, however, American publications "nosed out" the facts (or something near them) and created much interest on both sides of the Atlantic. There was a period of unofficial publication when many of the facts were distorted. American press kites were flown in order to invite denials or corrections, and thus America became fairly well informed as to the existence of DDT and some of the things which were being achieved by its use, though its early history and development were still very vague.

At last, on 2 August 1944, the British Government released the story of DDT to the press, and it is such an interesting document that we reproduce it here in full:

"Synthetic Insecticide which stopped a Typhus Epidemic"

"The full story can now be told of what has been described as one of the greatest scientific discoveries of the last decade, a synthetic multi-purpose insecticide which has already stopped a typhus epidemic, threatens the existence of the malaria-carrying mosquito and household insect pests, and is capable of controlling many of the insects which now do untold damage to food crops.

"It is '*p* : *p*'-dichloro-diphenyl-1, 1, 1,-trichloroethane'—DDT for short. DDT is lethal to the body louse which transmits typhus fever to man and is capable of killing mosquitoes, thus helping to control the spread of malaria. Dysentery, enteric, and cholera will be capable of better control than heretofore, as DDT

is deadly towards the various species of flies, whilst it has already been used successfully to destroy bugs, fleas, cockroaches, beetles, cabbage worms, apple-codling moths, and aphids. Its efficacy is almost unique, as on insects it acts both as a contact and as a stomach poison, although it is non-toxic to man and other warm-blooded animals in the concentration normally used. It also has the remarkable property of being effective for many weeks after application. For instance, when sprayed on walls, it kills any fly alighting thereon, in some cases for as long as three months afterwards; a bed sprayed with DDT is deadly to bed-bugs for 3 to 6 months; clothing impregnated with it is safe from lice for a month, even after several launderings; whilst a swamp properly treated may be freed from breeding mosquitoes for a considerable period.

"The first full-scale use of DDT in a war sector was in Naples at the turn of the year. Here in December 1943 typhus broke out in the overcrowded civilian population which in the main was poverty-stricken, dirty, and louse-ridden. As soon as the Allied Forces were in control, vigorous steps were taken to suppress the outbreak by mass disinfestation. This was first done by dusting with non DDT-containing lousicides, but as soon as DDT became available it was used solely and with signal success.

"During January 1944, 1,300,000 civilians were dusted at two delousing stations (72,000 on the peak day) and within three weeks the outbreak in the city of Naples was completely under control, the weekly number of civilian cases reported falling sharply from 305 in the peak week ending 11 January to 155 the following week.

"DDT has thus already made medical history of tremendous significance, as never before has a typhus outbreak been arrested in mid-winter.

"It will, therefore, be the main protection for Allied troops in liberated Europe where typhus is endemic over large areas. With this end in view, British troops going to the Continent now have a standard issue of DDT impregnated shirts which effectively protect the wearer against lice for two months, even after regular washing.

"For the troops, however, protection against malaria and dysentery is even more important, and in the operations which are being carried out in the Far East, DDT is going to find its most important war use. In this theatre of war large areas are

made practically untenable by the enormous population of malaria-carrying mosquitoes. Added to oil, however, which has been used against mosquito larvae ever since the Panama Canal was built, DDT produces a larvicide of such potency that only a fraction of the oil previously employed will henceforth be required, and this new preparation will remain toxic to the mosquito larvae for days afterwards.

"The majority of casualties in all wars are not directly due to enemy action. In Sicily the 7th and 8th Armies suffered more casualties from malaria than from battle. Many more people are afflicted by disease than are killed or wounded, and so far as our knowledge extends, more people die from the epidemics following war than are killed by enemy action during it.

"Of the Serbians who fought in the last war 25% perished from typhus, and the Russian losses during 1914–18 are officially estimated at several millions, while in Poland there were some 400,000 cases of typhus with a 10% mortality-rate.

"When, after the Armistice in 1918, a vast army of soldiers and refugees returned from malarial districts to Europe the disease spread in epidemic form over the whole of South-eastern Europe, affecting as much as 90% of the population in some regions. A distinguished scientist wrote recently that the post-war ravages of malaria and dysentery probably accounted for well over a million deaths. After the last war epidemics of typhus swept Poland, Rumania, Lithuania, the Near East, and Russia. It has been computed that during this period there were more than 25 million cases of typhus in the territories controlled by the Soviet Republic, with 2½ to 3 million deaths.

"Although DDT was first made in 1874 it was not heard of again until 1939, when J. R. Geigy S.A. of Basle, the Swiss dye-stuffs company, found that it killed bugs and later used it to check a plague of potato beetles in Switzerland.

"The British branch of the Geigy Company brought this compound to the notice of the British Government in 1942, which at that time was seeking to find a substitute for derris and pyrethrum, two natural insecticides hitherto used to combat the insect carriers of typhus and malaria. Supplies of these were largely reduced when Japan entered the war, as Japanese sources of pyrethrum flowers were lost, and when the British and Netherlands East Indies were captured by the enemy, important sources of derris disappeared as abruptly. At the same time, the United

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