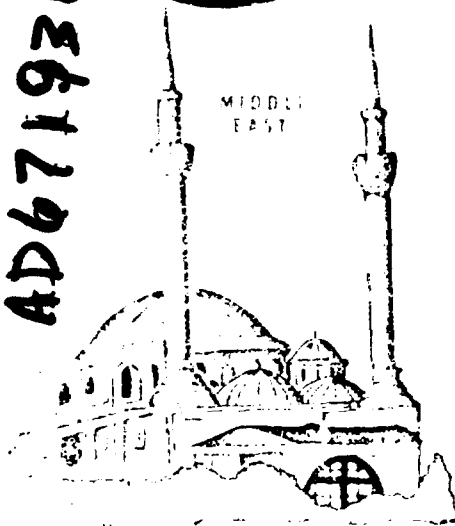


**THE U.S. LOGISTICS GROUP
DETACHMENT 36
USAFB
EPIDEMIOLOGY**

PROFESSIONAL REPORT

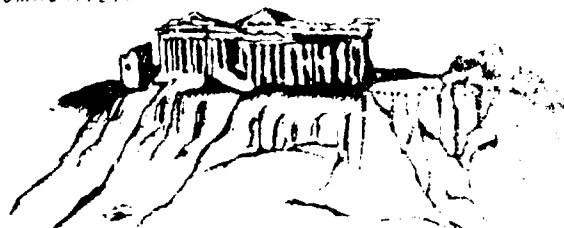
No. 68-7

AD671936



TÜRKİYE
CUMHURİYETİ

BAŞKENTİ
ANKARA



**RESISTANCE LEVELS OF IZMIR, TURKEY
BEDBUGS AND COCKROACHES TO INSECTICIDES
1966-67**

20 June 1968

Project Number 66-1

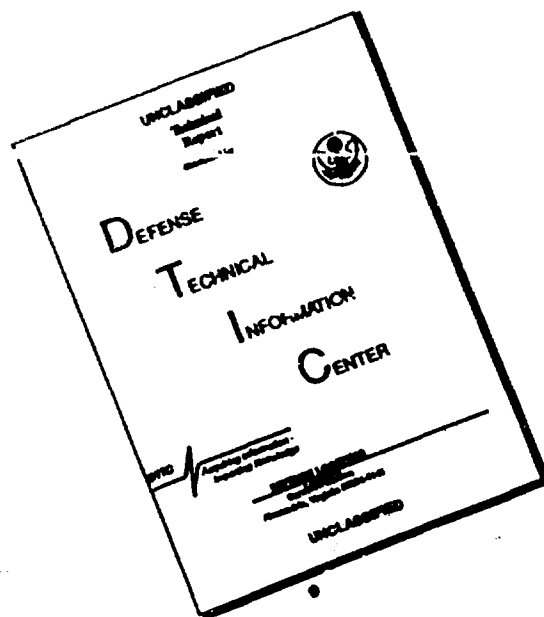


INTERNATIONAL FELLOWSHIP THROUGH MEDICINE



23

DISCLAIMER NOTICE



THIS DOCUMENT IS BEST QUALITY AVAILABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.


FOREWORD

This publication is prepared and disseminated for the specific purpose of providing epidemiological information within the general scope of the USAF Aerospace Medicine Program (AFM 161-2, dated 1 October 1962). The USAF Epidemiological Services are concerned with the relationships of various factors and conditions which contribute to injuries and to the frequency and distribution of all illness among Air Force personnel (AFR 161-12, dated 10 November 1964). The use of information herein for purposes other than as specified above relieves the authors and the USAF of any responsibility or obligation.

Qualified requesters may obtain copies of this publication from DDC or Det 36 or CFSTI.

The authors are especially indebted to SSgt Alan L. Morley for illustrations used in this study.

This report has been reviewed and is approved:


GEORGE W. POWELL
Lt Col USAF MC
Commander

This document has been approved for public release and sale; its distribution is unlimited.

DEPARTMENT OF THE AIR FORCE
TUSLOG DETACHMENT 36 (USAFE)
APO New York 09224

EPIDEMIOLOGY

Report No. 68-7

RESISTANCE LEVELS OF IZMIR, TURKEY
BEDBUGS AND COCKROACHES TO INSECTICIDES
1966-67

20 June 1968

Dean A. Garrett, Maj, USAF BSC Principal Investigator *
Jerry S. Agee, TSgt, USAF
Everett R. Gremminger, Sgt, USAF
Warren E. Morgan, Sgt, USAF

PROJECT NO. 66-1

* Present Address: USAF AEROSP MED SC (AFSC)
Brooks AFB TX 78235

ABSTRACT

During 1966, 67 and 68 tests were conducted with Bedbugs, Cimex lectularius, German cockroaches, Blatella germanica, and American cockroaches, Periplaneta americana strains obtained in Izmir Turkey during 1966-67 to determine their resistance to various concentrations of diazinon, malathion and dieldrin.

Results indicate that 0.5% diazinon should control bedbugs and 0.05% diazinon should control German cockroaches and 3.0% malathion should control American cockroaches. For combined German and American cockroach infestations we recommend 3.0% malathion in the absence of American/diazinon data.

TÜRKÇE ÖZET

1966, 1967 ve 1968 yıllarında Tahtakurusu Cimex lectularius, Alman hamam böceği, Blatella Germanica, ve Amerikan hamam böcekleri Periplaneta americana üzerinde deneyler yapılmış ve 1966-1967 yılları süresinde İzmir, Türkiye'de üretilen bu böceklerin muhtelif yoğunluktaki diazinon malthion ve dieldrin solusyonlarına karşı mukavemetleri araştırılmıştır.

Elde edilen neticelere göre 0.5% diazinon tahtakurularını, 0.05% diazinon Alman hamamböceklerini ve 3.0% malathion da Amerikan hamamböceklerini öldürmektedir. Alman ve Amerikan hamamböceklerinin birarada infestasyonu halinde şayet Amerikan/diazinon konusunda bilgi mevcut değilse 3.0% malathion solusyonu kullanılmasını tavsiye ederiz.

DEPARTMENT OF THE AIR FORCE
TUSLOG DETACHMENT 36 (USAFE)
APO New York 09224

EPIDEMIOLOGY

RESISTANCE LEVELS OF IZMIR, TURKEY
BEDBUGS AND COCKROACHES TO INSECTICIDES
1966-67

With the continued development of physiological resistance of insects to insecticides in use at military installations it is important to keep abreast of the resistance problem. In order to provide current information on insect resistance, tests must be conducted on a continuing basis. Being cognizant of this problem and due to frequent requests for recommendations for the latest control data, preliminary laboratory resistance tests were conducted during 1966, 67 and 68 on bedbugs (Cimex lectularius) and cockroaches (Blatella germanica and Periplaneta americana) from Izmir, Turkey.

There is no evidence at the present time to indicate that bedbugs are natural vectors of diseases. However, it has been shown that they can experimentally transmit the pathogens of plague, relapsing fever, leprosy, Kala-azar, and chagas disease. They are of medical importance to the military however, because they can produce considerable irritation and discomfort from their bites. It has been shown that the german cocroach, Blatella germanica, can experimentally transmit bacteria (e.g. Salmonella typhimurium), fungi (e.g. Aspergillus) and serve as an intermediate host for nematode parasites (e.g. Spirura gastrophilia and Gongylonema neoplasticum).¹

II

MATERIALS AND METHODS

The procedures used to determine the resistance of bedbugs and cockroaches to insecticides were those prescribed in Technical Information Memorandum No. 3, Methods for Determining the Susceptibility or Resistance of Insects to Insecticides, Armed Forces Pest Control Board, Washington, D. C., dated 30 January, 1959, and Test Methods for Insect Resistance, Supplement No. 2 to Armed Forces Manual on Pest Control, Defense Research Board, Department of National Defense, Canada, Ottawa 1967. These methods confine cockroaches and bedbugs to insecticide residues inside mason jars. Ebeling et al stated that the repellency of many contact insecticides used against German cockroaches greatly handicapped their field performance. They describe another method where German cockroaches were allowed a choice between an illuminated untreated area and a dark shelter partly or completely treated with insecticide. They found that the more potent, rapidly acting insecticides tended to be most repellent; so there was a rough inverse correlation between the efficacy judged by the confinement and free choice methods. Our tests were limited to the confinement to insecticide residue method.²

Test concentrations for all insecticides were prepared from emulsifiable concentrate stock solutions. The American cockroach tests were replicated five times with five specimens per replicate. The German cockroach tests were replicated five times with 10 specimens per replicate. For each species, one of the above replicates was untreated and served as a control. The number of insects used per replicate was determined by the number available at the time the tests were conducted.

The results were plotted on logarithmic - probability paper. The regression line was fitted by eye to determine the lethal time required to knockdown 50% and 90% of the specimens. This time duration will hereinafter be referred to as LT50 and LT90.

Bedbugs: The bedbugs tested were from a colony established from five bedbugs obtained from the quarters of a military member in Izmir, Turkey in June 1967. The insecticides tested were diazinon at concentrations of .0001%, 0.01% and 1.0% and malathion at 1.0%. Test insects were all adult males.

German cockroaches: The cockroaches tested were from a colony established from specimens obtained from a civilian hotel in Izmir, Turkey in August 1966. The insecticides tested were diazinon at concentrations of 0.001%, 0.01%, 0.05%, malathion at concentrations of 0.05%, 0.5%, 5.0% and dieldrin at concentrations of 0.1%, 1.0% and 10.0%. Test insects were adult males.

American cockroaches: The cockroaches tested were from a colony established from specimens obtained from an infestation in the Microbiology section, Detachment 36 leased office and laboratory building Izmir, Turkey in May 1966. The insecticide tested was malathion at a 3% concentration. Test specimens were male, female and mature nymphs. Due to the long life cycle of this species there were only sufficient specimens to conduct a single test.

III

RESULTS

Data from the results of the insecticide resistance tests is presented below.

<u>BEDBUGS</u> (<u>Cimex lectularius</u>)	<u>DIAZINON</u>	<u>KNOCKDOWN TIME</u>	
		<u>LT50</u>	<u>LT90</u>
<u>Concentration (%)</u>			
0.0001		LT50 not reached at end of 72 hrs	
0.01		3:18* No LT90 at end of 72 hrs	
1.0		1:12	1:36 (atch 2)
Control		No mortality at end of 72 hrs	
	<u>MALATHION</u>		
1.0		1:24	2:18 (atch 3)
Control		No mortality at end of 72 hrs	

* 3 hrs 18 minutes

<u>GERMAN COCKROACHES</u> (<u>Blatella germanica</u>)		<u>DIAZINON</u>	<u>KNOCKDOWN TIME</u>	
<u>Concentration (%)</u>		<u>LT50</u>	<u>LT90</u>	
0.001		2:50	4:12 (atch 4)	
0.01		:48 min	1:18 (atch 5)	
0.05		:48 min	1:12 (atch 6)	
Control		No mortality at end of 12 hrs.		
		<u>MALATHION</u>		
0.05		2:48	5:48 (atch 7)	
0.5		:36	:48 (atch 8)	
5.0		:24	:40 (atch 9)	
Control		No mortality at end of 12 hrs		
		<u>DIELDRIN</u>		
0.1		84 hrs	150 hrs (atch 10)	
1.0		45 hrs	140 hrs (atch 11)	
10.0		40 hrs	56 hrs (atch 12)	
Control		No mortality at end of 150 hrs		
<u>AMERICAN COCKROACHES</u> (<u>Periplaneta americana</u>)		<u>MALATHION</u>	<u>KNOCKDOWN TIME</u>	
<u>Concentration (%)</u>		<u>LT50</u>	<u>LT90</u>	
3.0		:30	:48 (atch 13)	
Control		No mortality at end of 1 hr		

IV

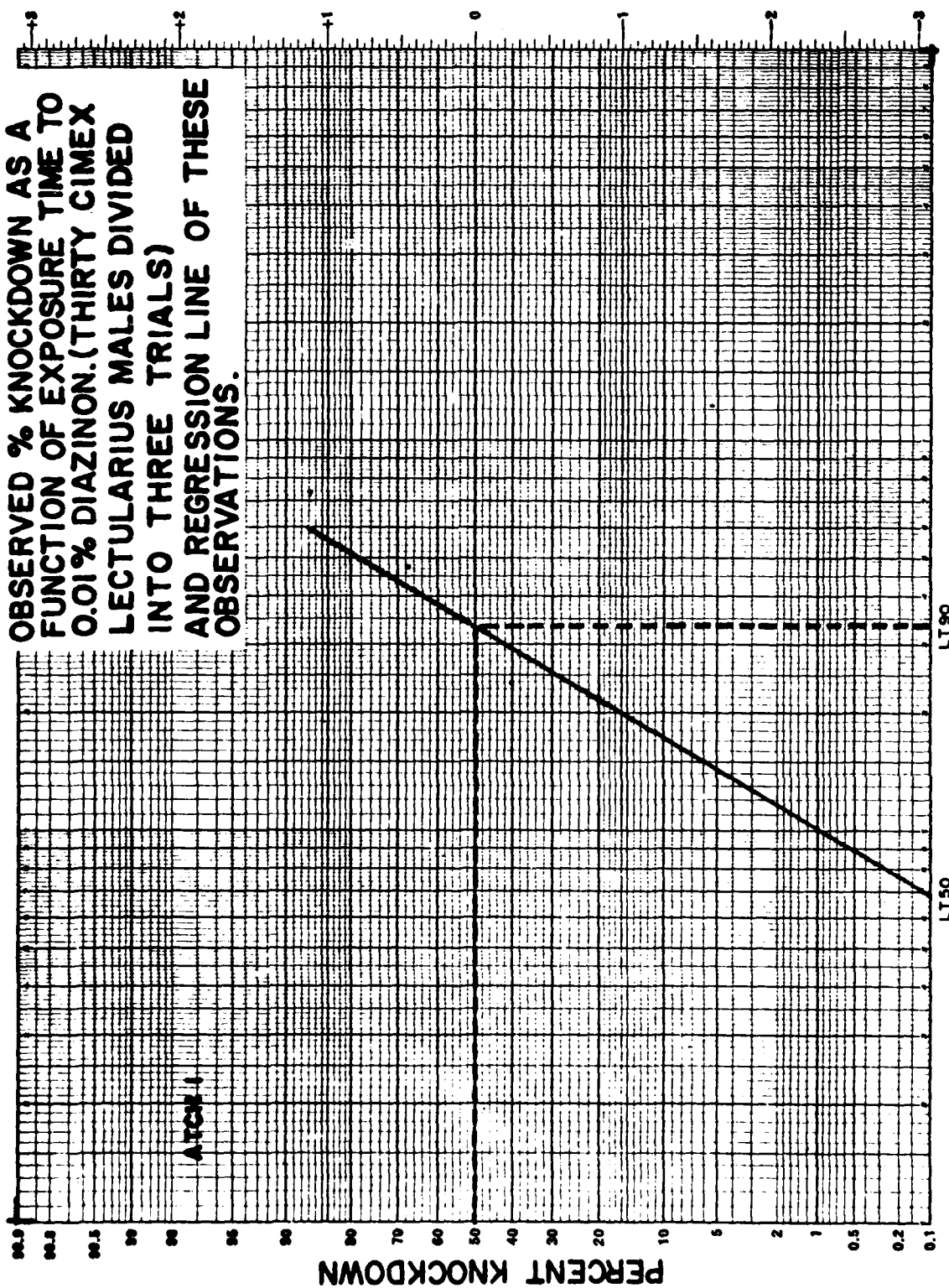
DISCUSSION AND CONCLUSIONS

Bedbugs: These tests show that the Izmir strain of bedbugs was susceptible to 1.0% diazinon (LT50 - 1:12 and LT90 - 1:36). However, at a concentration of 0.01% the LT50 was reached at 3 hrs 18 min but 90% mortality was not attained and with 0.001% neither an LT50 or LT90 was reached. It appears that good control could be expected with 1.0% concentration or greater but control with lesser concentration would be doubtful. Good control could also be expected with 1.0% malathion concentration (LT50 - 1:24 and LT90 - 2:18) or greater. Results are not available on lesser concentrations.

German cockroaches: The tests on the Izmir strain of German cockroaches showed that they were susceptible to concentrations as low as 0.001% diazinon (LT50 - 2:50 and LT90 - 4:12) and 0.5% malathion (LT50 - 2:48 and LT90 - 5:48). Just the opposite appears to be true with 10.0% dieldrin (LT50 - 40 hrs and LT90 - 56 hrs). From these results it appears that good control could be obtained with both diazinon and malathion, but resistance is indicated with dieldrin.

American cockroaches: Due to a shortage of cockroaches only one test (3% malathion) was conducted with American cockroaches. They were highly susceptible to this concentration with an LT50 at 24 minutes and LT90 at 40 minutes. Additional tests are indicated with lesser concentrations to obtain more meaningful data.

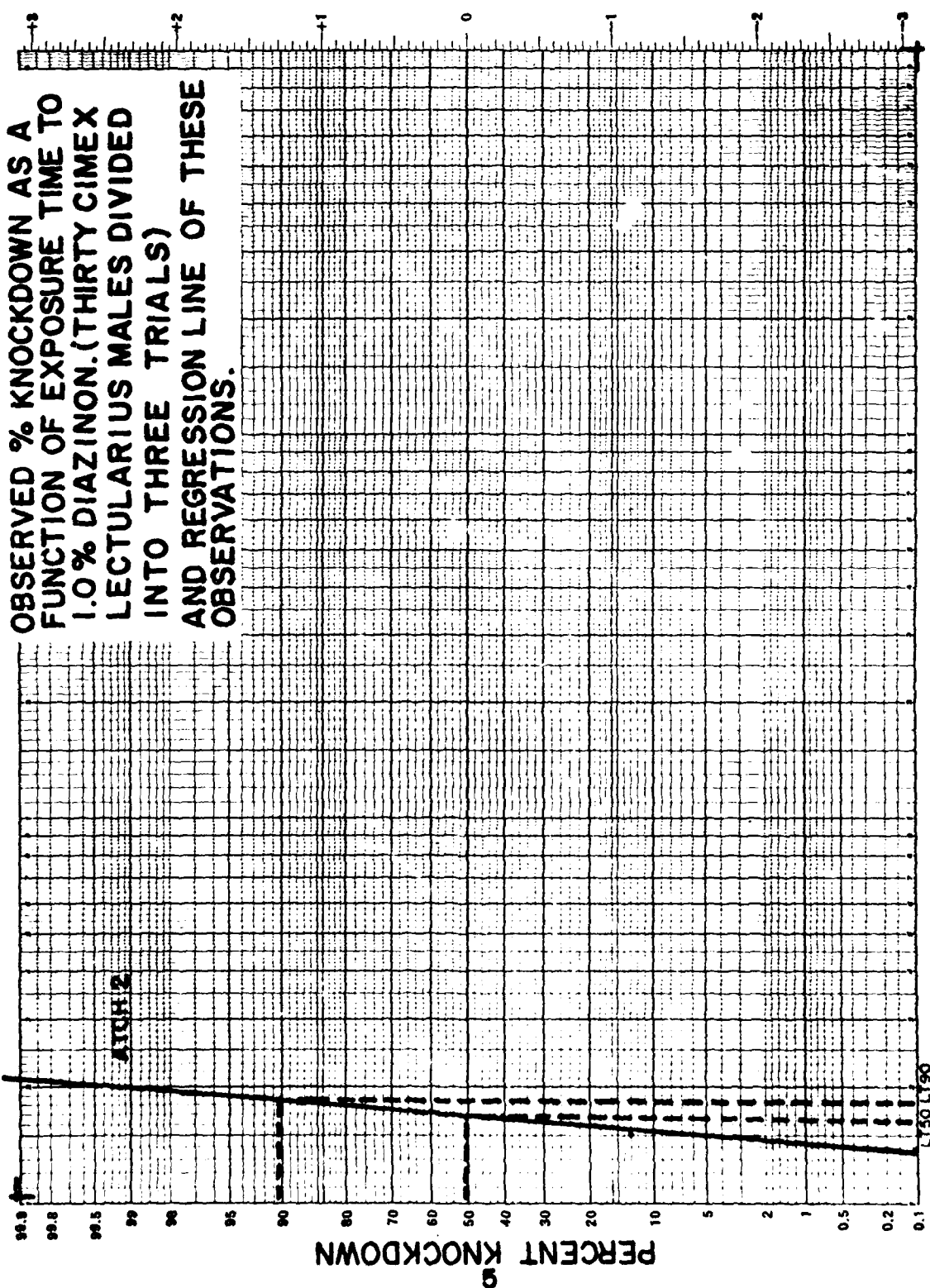
OBSERVED % KNOCKDOWN AS A
FUNCTION OF EXPOSURE TIME TO
0.01% DIAZINON.(THIRTY CIMEX
LECTULARIUS MALES DIVIDED
INTO THREE TRIALS)
AND REGRESSION LINE OF THESE
OBSERVATIONS.



TIME IN HOURS OF EXPOSURE OF INSECT TO INSECTICIDE

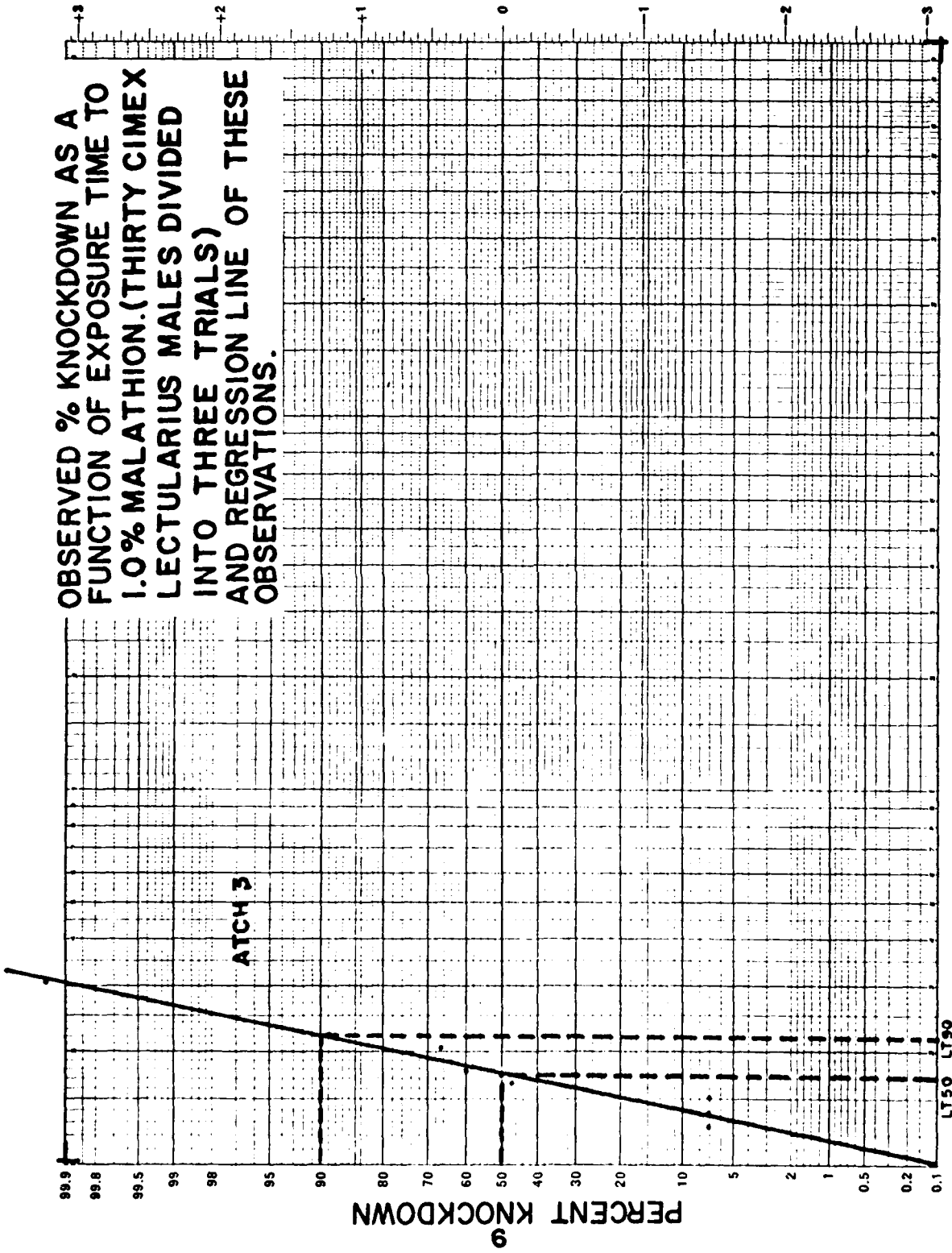
PERCENT KNOCKDOWN

OBSERVED % KNOCKDOWN AS A
 FUNCTION OF EXPOSURE TIME TO
 1.0% DIAZINON.(THIRTY CIMEX
 LECTULARIUS MALES DIVIDED
 INTO THREE TRIALS)
 AND REGRESSION LINE OF THESE
 OBSERVATIONS.



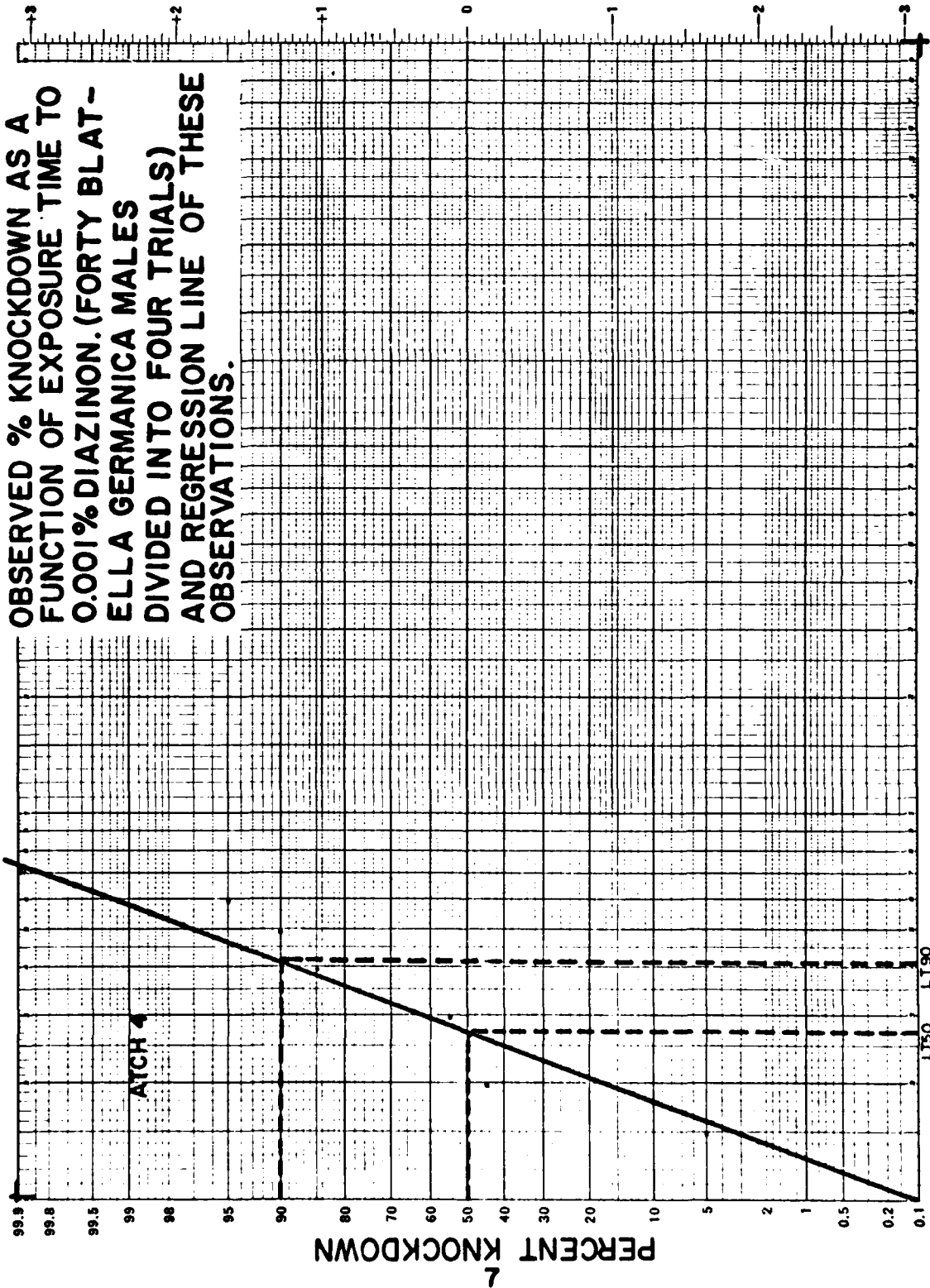
TIME IN HOURS OF EXPOSURE OF INSECT TO INSECTICIDE

OBSERVED % KNOCKDOWN AS A
 FUNCTION OF EXPOSURE TIME TO
 1.0% MALATHION.(THIRTY CIMEX
 LECTULARIUS MALES DIVIDED
 INTO THREE TRIALS)
 AND REGRESSION LINE OF THESE
 OBSERVATIONS.



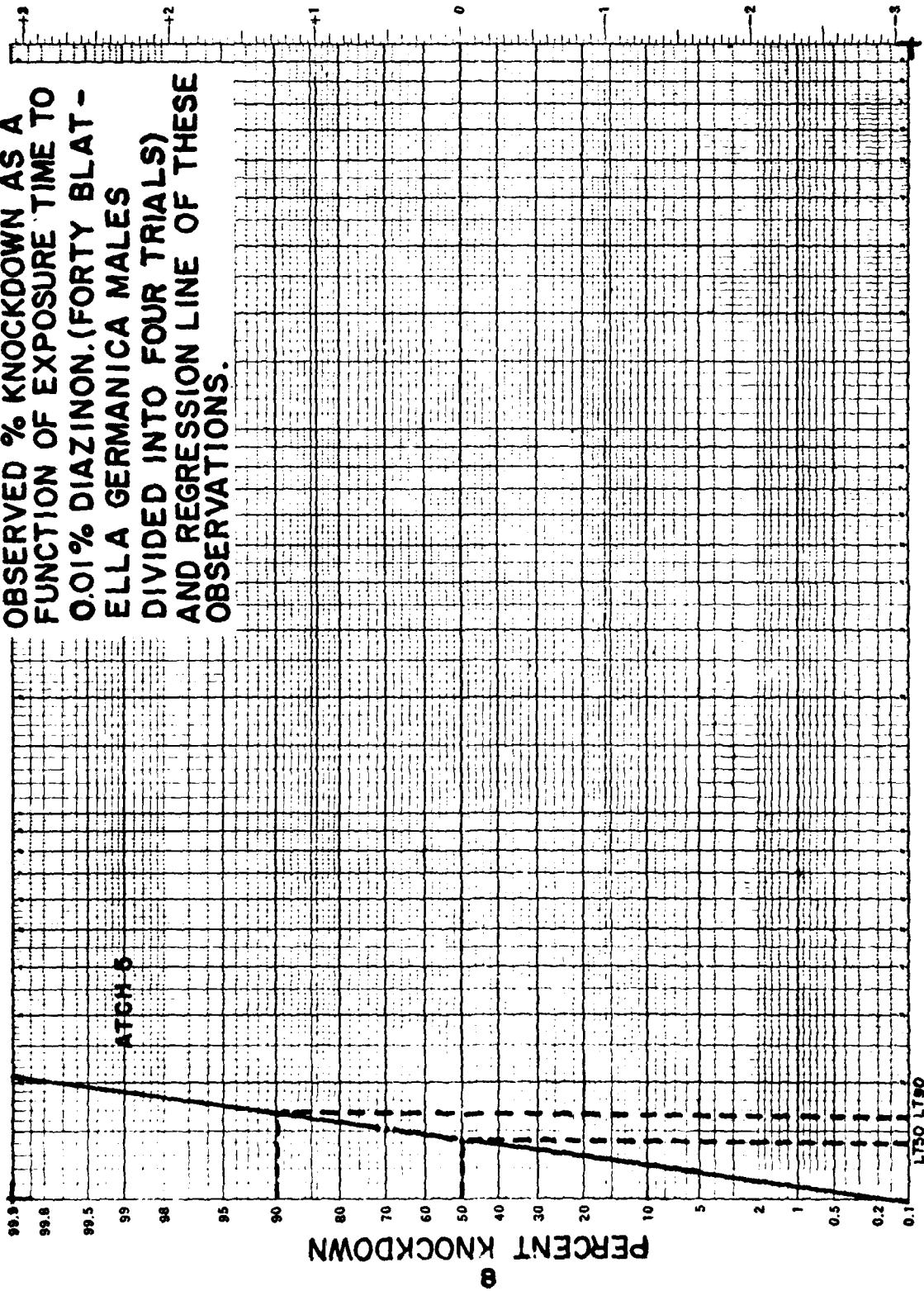
TIME IN HOURS OF EXPOSURE OF INSECT TO INSECTICIDE

OBSERVED % KNOCKDOWN AS A
 FUNCTION OF EXPOSURE TIME TO
 0.001% DIAZINON. (FORTY BLAT-
 ELLA GERMANICA MALES
 DIVIDED INTO FOUR TRIALS)
 AND REGRESSION LINE OF THESE
 OBSERVATIONS.

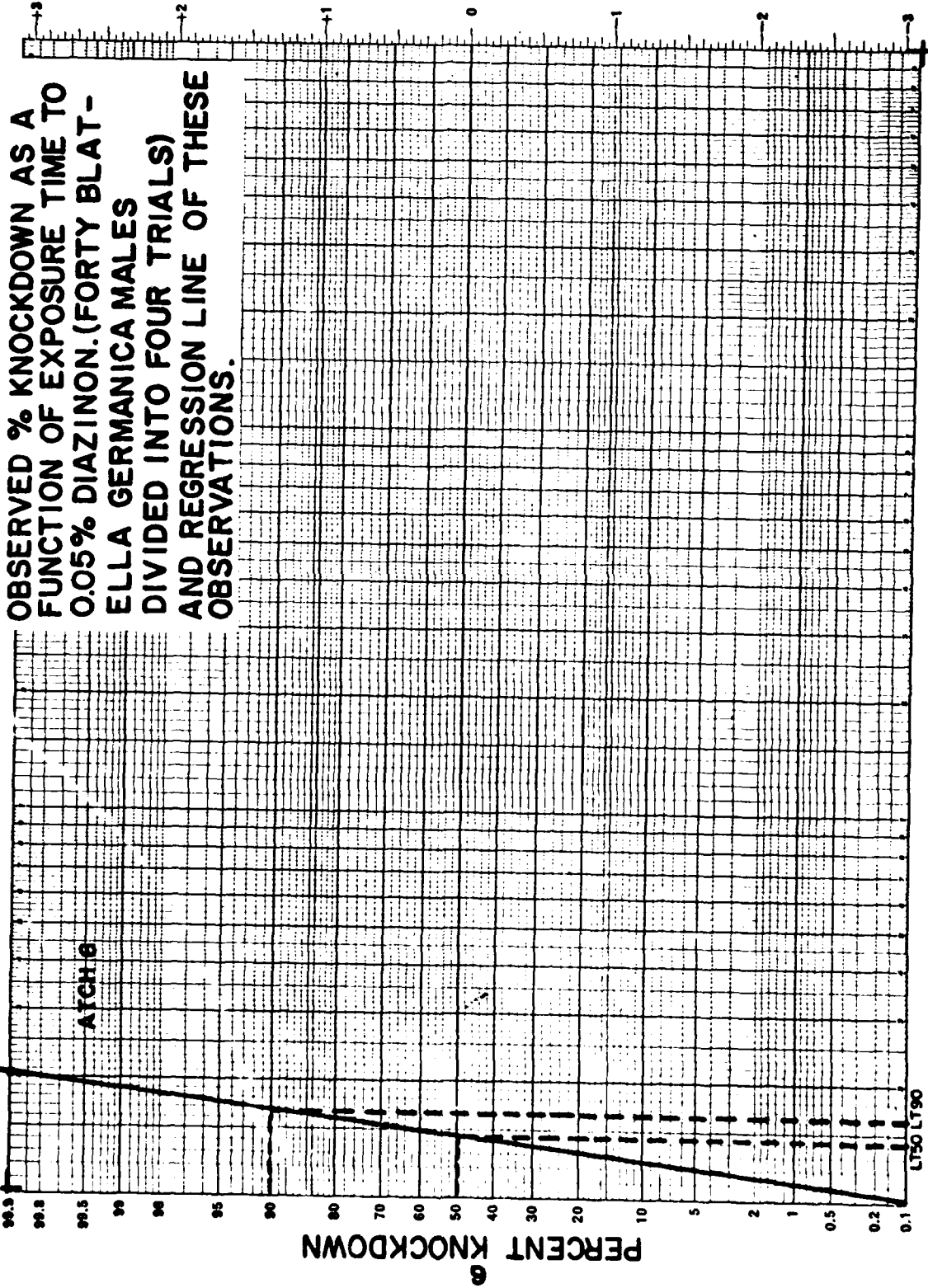


TIME IN HOURS OF EXPOSURE OF INSECT TO INSECTICIDE

OBSERVED % KNOCKDOWN AS A
 FUNCTION OF EXPOSURE TIME TO
 0.01% DIAZINON. (FORTY BLAT-
 ELLA GERMANICA MALES
 DIVIDED INTO FOUR TRIALS)
 AND REGRESSION LINE OF THESE
 OBSERVATIONS.



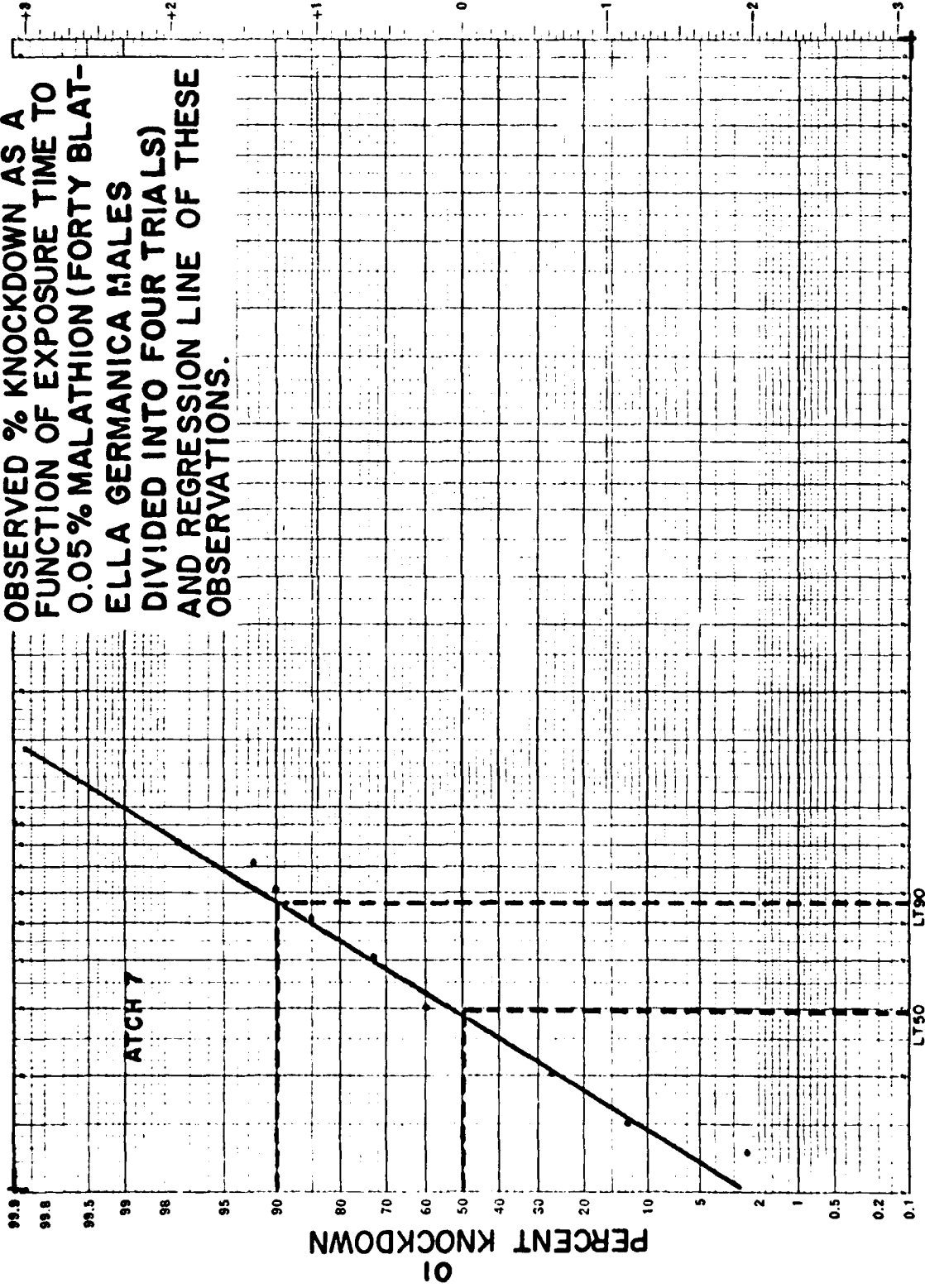
TIME IN HOURS OF EXPOSURE OF INSECT TO INSECTICIDE



OBSERVED % KNOCKDOWN AS A FUNCTION OF EXPOSURE TIME TO 0.05% DIAZINON. (FORTY BLATTELLA GERMANICA MALES DIVIDED INTO FOUR TRIALS) AND REGRESSION LINE OF THESE OBSERVATIONS.

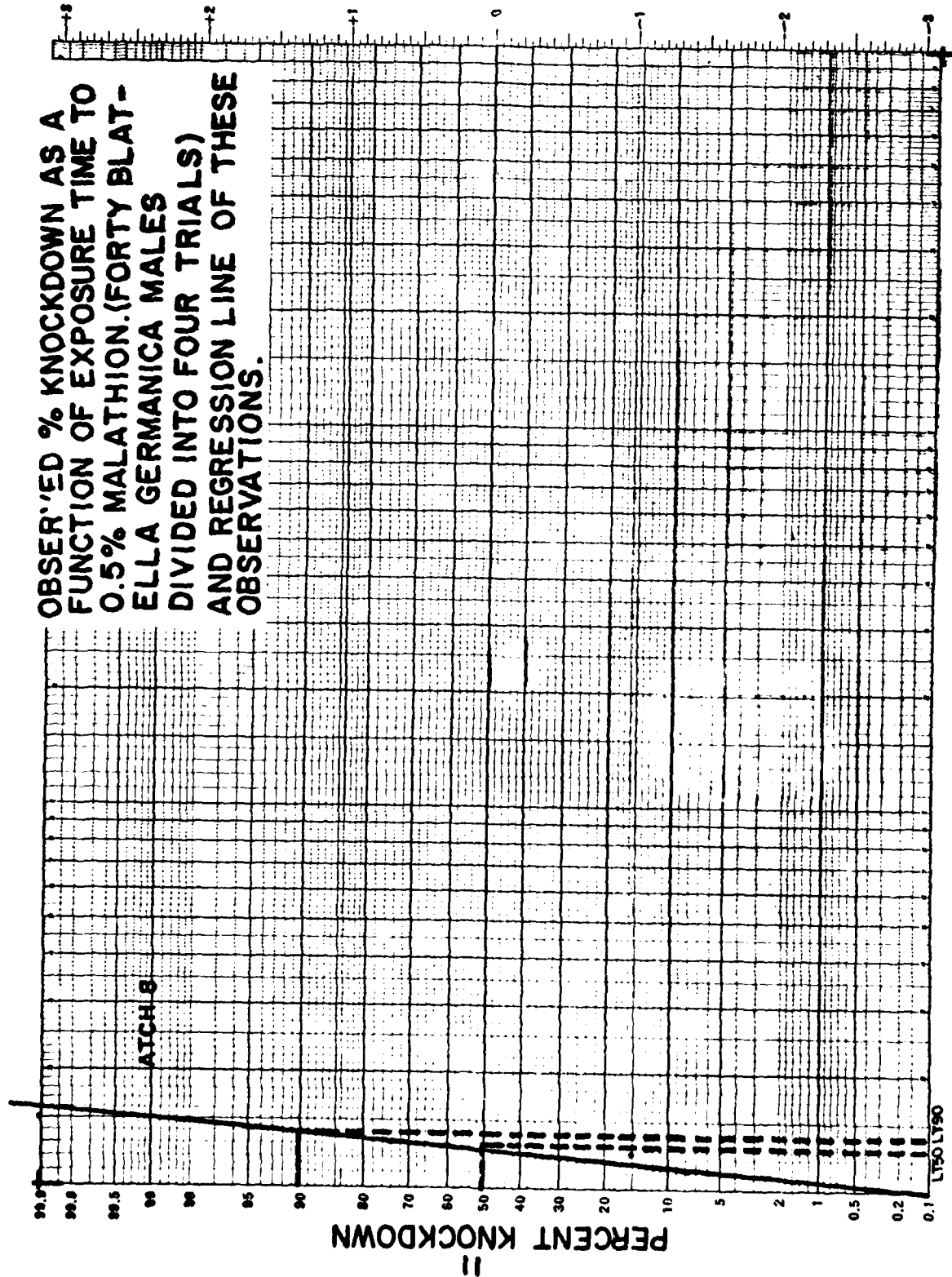
TIME IN HOURS OF EXPOSURE OF INSECT TO INSECTICIDE

OBSERVED % KNOCKDOWN AS A
 FUNCTION OF EXPOSURE TIME TO
 0.05% MALATHION (FORTY BLAT-
 ELLA GERMANICA MALES
 DIVIDED INTO FOUR TRIALS)
 AND REGRESSION LINE OF THESE
 OBSERVATIONS.



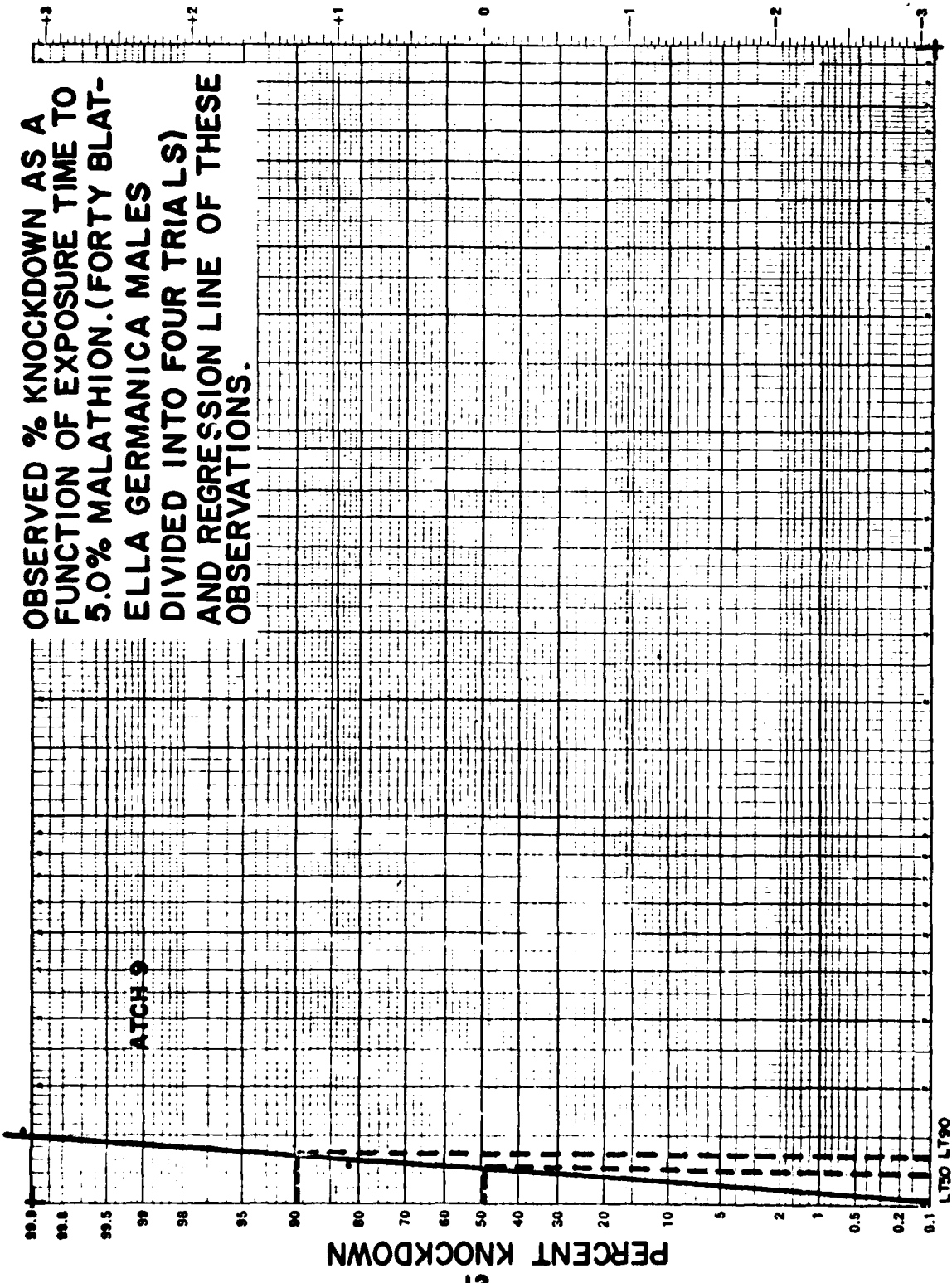
TIME IN HOURS OF EXPOSURE OF INSECT TO INSECTICIDE

OBSERVED % KNOCKDOWN AS A
 FUNCTION OF EXPOSURE TIME TO
 0.5% MALATHION. (FORTY BLAT-
 ELLA GERMANICA MALES
 DIVIDED INTO FOUR TRIALS)
 AND REGRESSION LINE OF THESE
 OBSERVATIONS.



TIME IN HOURS OF EXPOSURE OF INSECT TO INSECTICIDE

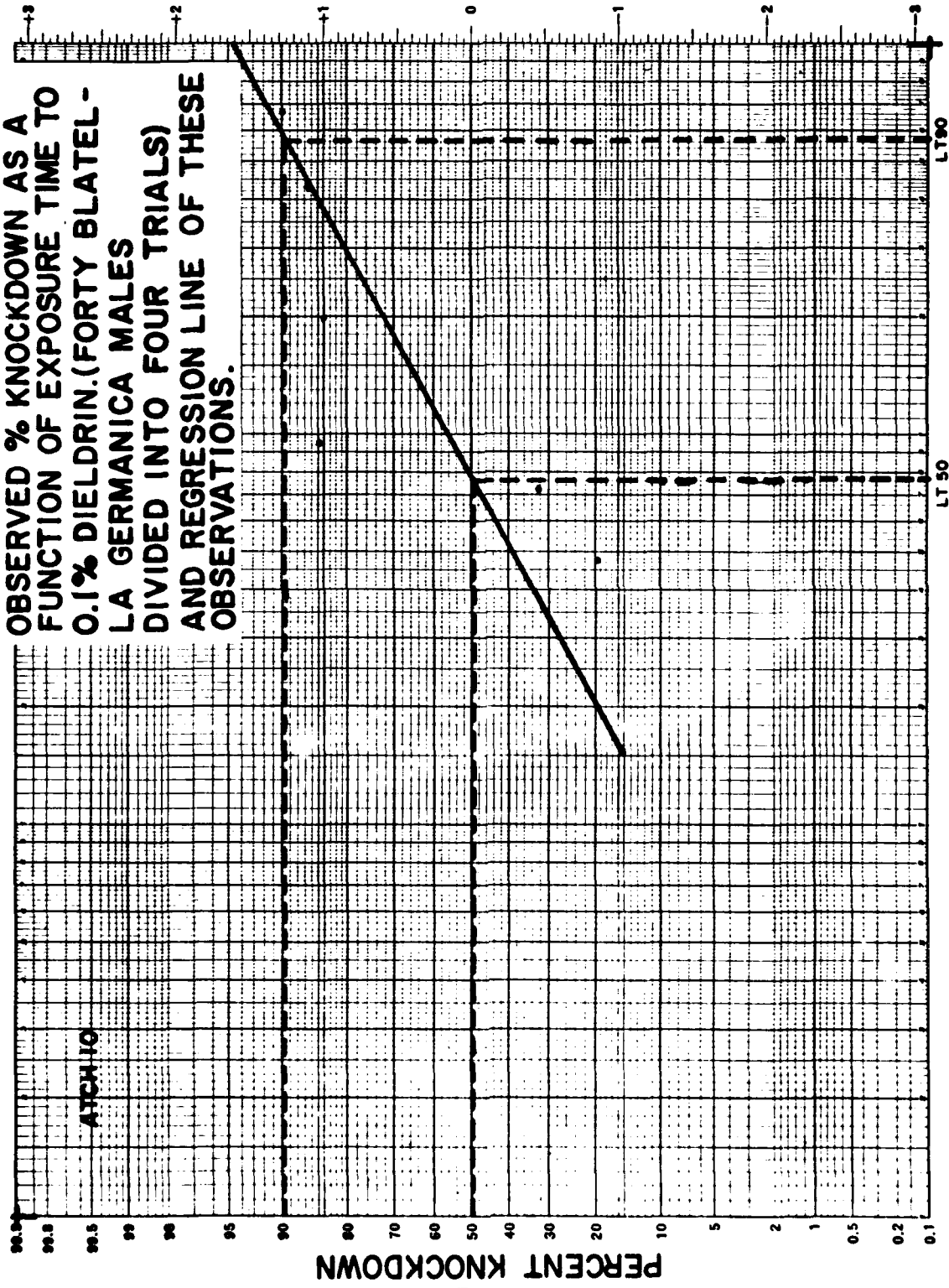
OBSERVED % KNOCKDOWN AS A
 FUNCTION OF EXPOSURE TIME TO
 5.0% MALATHION. (FORTY BLAT-
 ELLA GERMANICA MALES
 DIVIDED INTO FOUR TRIALS)
 AND REGRESSION LINE OF THESE
 OBSERVATIONS.



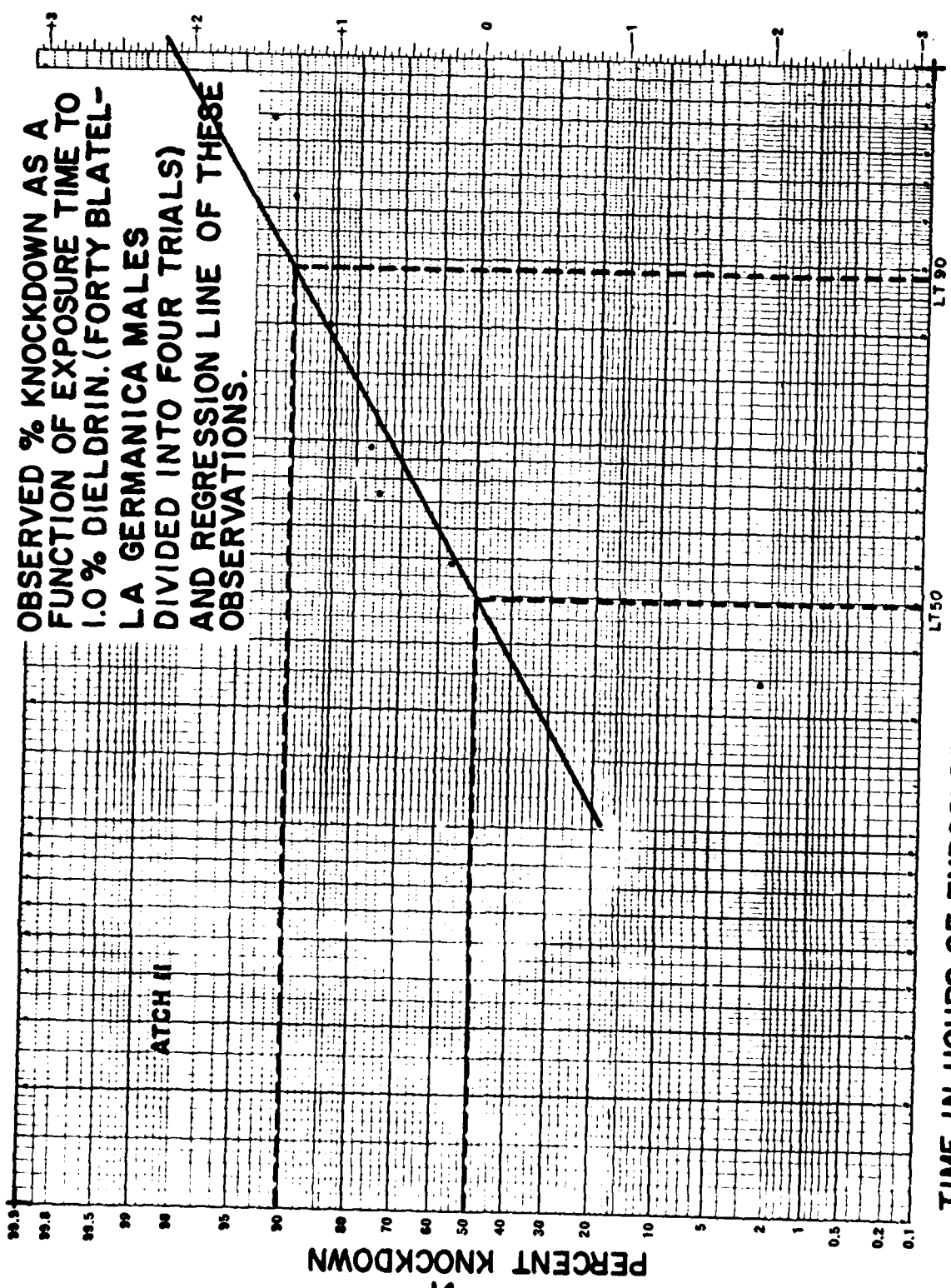
ATCH 9

TIME IN HOURS OF EXPOSURE OF INSECT TO INSECTICIDE

OBSERVED % KNOCKDOWN AS A
 FUNCTION OF EXPOSURE TIME TO
 0.1% DIELDRIN.(FORTY BLATEL-
 LA GERMANICA MALES
 DIVIDED INTO FOUR TRIALS)
 AND REGRESSION LINE OF THESE
 OBSERVATIONS.



TIME IN HOURS OF EXPOSURE OF INSECT TO INSECTICIDE

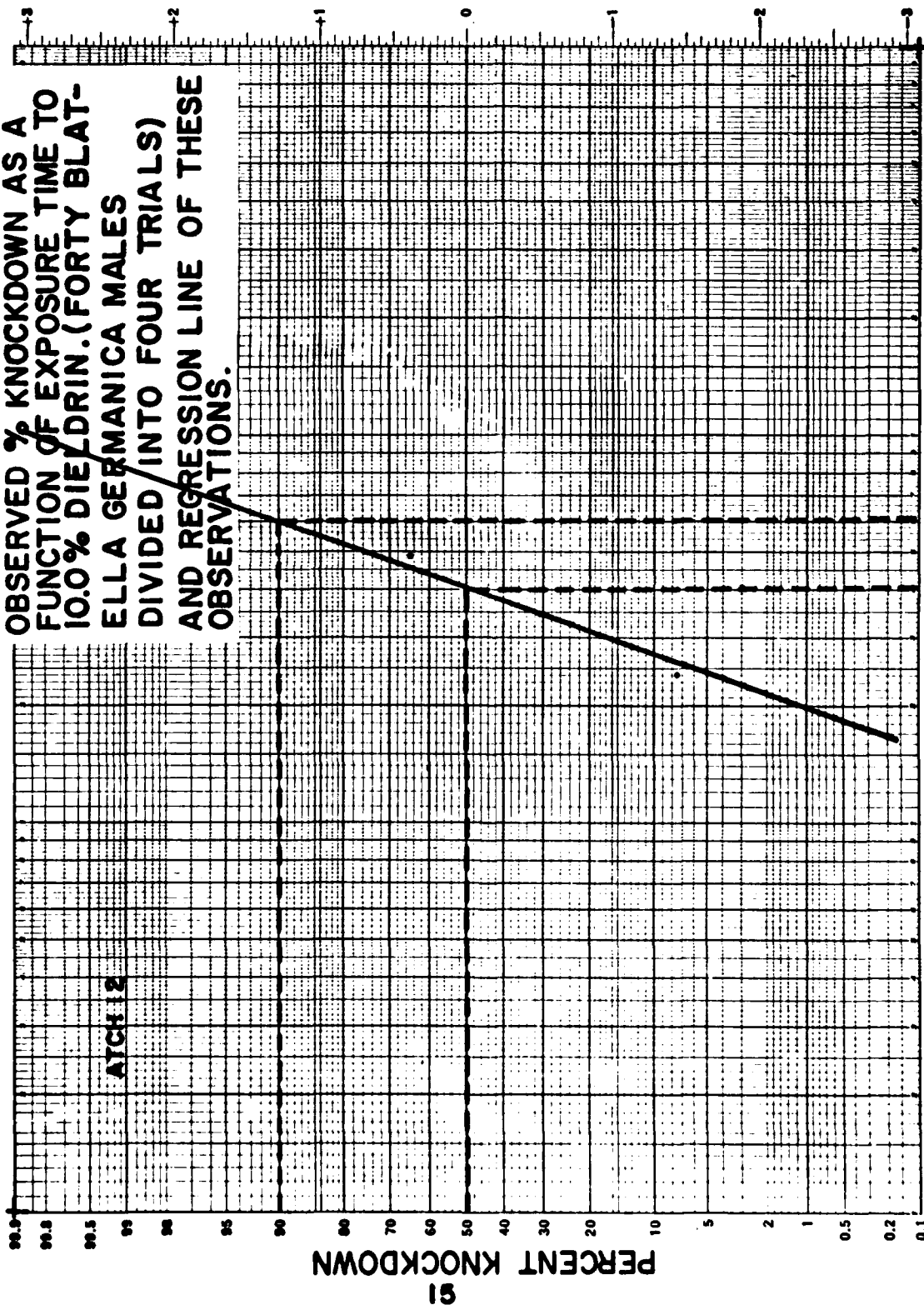


OBSERVED % KNOCKDOWN AS A
 FUNCTION OF EXPOSURE TIME TO
 1.0% DIELDRIN. (FORTY BLATEL-
 LA GERMANICA MALES
 DIVIDED INTO FOUR TRIALS)
 AND REGRESSION LINE OF THESE
 OBSERVATIONS.

ATCH II

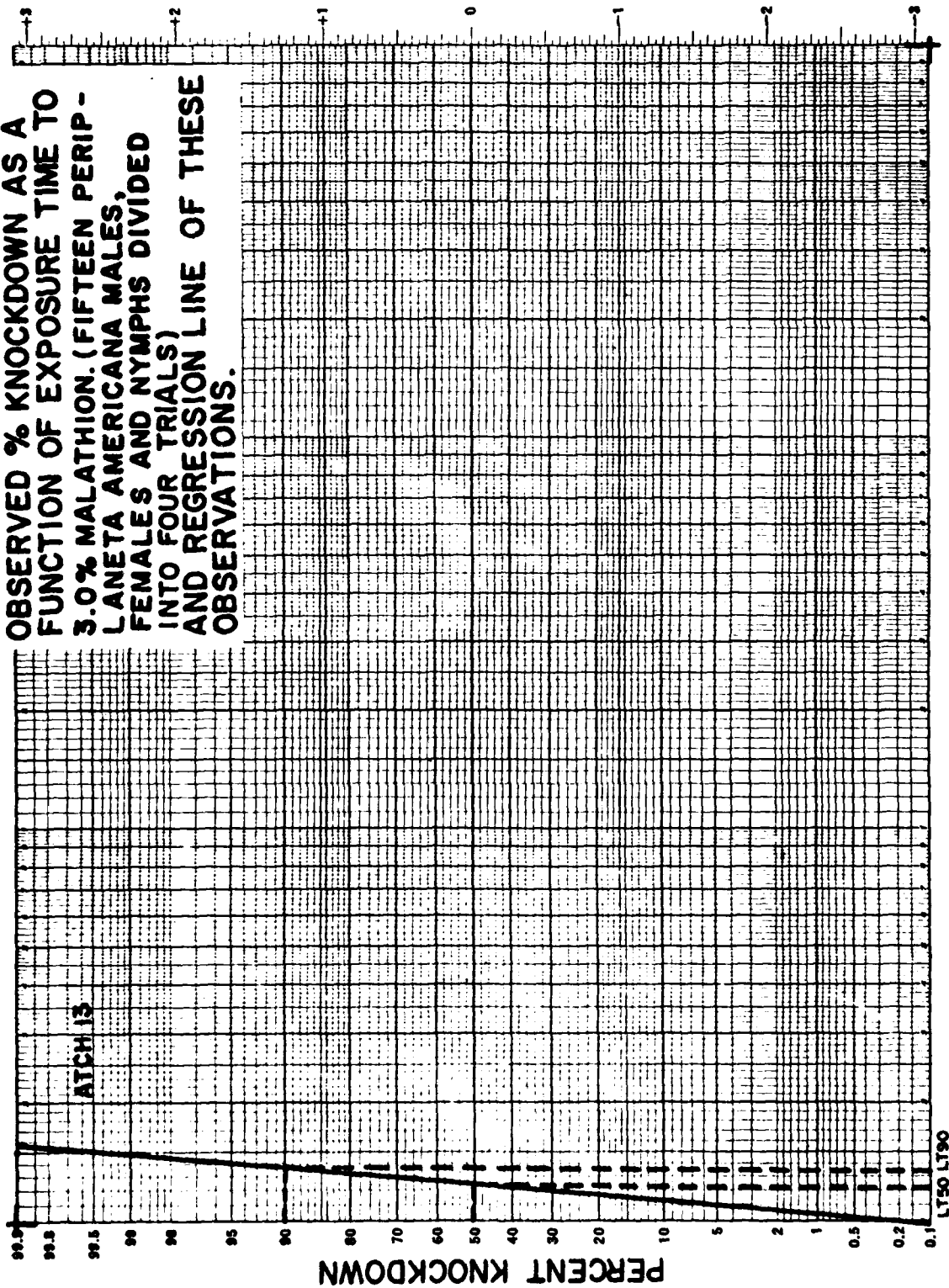
TIME IN HOURS OF EXPOSURE OF INSECT TO INSECTICIDE

OBSERVED % KNOCKDOWN AS A
 FUNCTION OF EXPOSURE TIME TO
 10.0% DIE/DLRIN. (FORTY BLAT-
 ELLA GERMANICA MALES
 DIVIDED INTO FOUR TRIALS)
 AND REGRESSION LINE OF THESE
 OBSERVATIONS.



TIME IN HOURS OF EXPOSURE OF INSECT TO INSECTICIDE

OBSERVED % KNOCKDOWN AS A
 FUNCTION OF EXPOSURE TIME TO
 3.0% MALATHION. (FIFTEEN PERIP-
 LANETA AMERICANA MALES,
 FEMALES AND NYMPHS DIVIDED
 INTO FOUR TRIALS)
 AND REGRESSION LINE OF THESE
 OBSERVATIONS.



TIME IN HOURS OF EXPOSURE OF INSECT TO INSECTICIDE

PERCENT KNOCKDOWN

SELECTED BIBLIOGRAPHY

1. Herms, William B. and M. T. James. 1965 *Medical Entomology*. 643 pgs.
2. Ebeling, W., D.A. Reiersen and R.E. Wagner. 1967. Influence of Repellency on the Efficacy of Blatticides. II. Laboratory Experiments with German cockroaches. *J. Econ. Ent.* 60:5. In *Tropical Diseases Bulletin*. 65:4. Ref. No. 1192 pg 544.

DOCUMENT CONTROL DATA R & D

1. TITLE AND SUBTITLE (Indicate if an indexing and abstracting service is to be used when the report requires classification)		2a. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	
2. AUTHOR (Last name, first name, middle initial, last name)		2b. GROUP	
3. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)		N/A	
4. TITLE AND SUBTITLE (Indicate if an indexing and abstracting service is to be used when the report requires classification)			
5. UNSUPPORTED ACTIVITY (Type of report and inclusive dates)			
May 1966 - June 1968			
6. AUTHOR (Last name, first name, middle initial, last name)			
William S. Anger, USAF, USAF - Operational Investigator William S. Anger, USAF, USAF William S. Anger, Sgt USAF William S. Anger, USAF			
7. PERIOD DATE		8a. TOTAL NO. OF PAGES	
June 1968		17	
8b. CONTRACT OR ORDER NUMBER		8c. NUMBER OF ILLUSTRATIONS (Include tables)	
A PROJECT NO. 60-1		Det 36 - PR - 68 - 7	
9. DISTRIBUTION STATEMENT (This declaration has been approved for public release and sale; reproduction is unlimited. Qualified requestors may obtain copies of this publication from DDC or Det 36 or CFSH.)			
10. SUPPLEMENTARY NOTES		11. NUMBER OF DOCUMENT AVAILABILITY	
None		Same as #1	

During 1966, 1967 and 1968 tests were conducted with Bedbugs, *Cimex lectularius* German cockroaches, *Blattella germanica* and American cockroaches, *Periplaneta americana* from strains obtained in Izmir Turkey during 1966-67 to determine their resistance to various concentrations of diazinon, malathion and dieldrin.

It is recommended that 0.5% diazinon should control bed bugs and 0.05% diazinon should control German cockroaches and 3.0% malathion should control American cockroaches. For controlled German and American cockroach infestations we recommend 0.5% malathion in the absence of American/diazinon data.

UNCLASSIFIED
Security Classification

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Cockroaches Bedbugs Resistance Susceptibility Diazinon Malathion Dieldrin Izmir, Turkey						